CinePlex®
Behavioral Research System

CAUTION
Camera Damage
Never connect or disconnect the camera while the power is on. The camera can be permanently damaged.

This Guide is for use in conjunction with a CinePlex System integrated with an OmniPlex® System

Plexon Inc
6500 Greenville Avenue, Suite 700
Dallas, Texas 75206
USA
<table>
<thead>
<tr>
<th>NOTE TO CINEPLEX V1 AND V2 USERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>The V3 version of CinePlex software is not compatible with hardware, software, or licensing for prior versions. <strong>DO NOT ATTEMPT TO INSTALL V3 ON SYSTEMS RUNNING PRIOR VERSIONS.</strong> It will not operate correctly, or possibly, not at all.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Caution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrostatic Discharge</strong></td>
</tr>
<tr>
<td>Some devices can be damaged by improper handling. Use appropriate electrostatic discharge (ESD) procedures when handling these devices. See <a href="http://www.esda.org/">http://www.esda.org/</a> for additional information on ESD procedures.</td>
</tr>
</tbody>
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<tbody>
<tr>
<td><strong>USB Security Key Damage</strong></td>
</tr>
<tr>
<td><em>Before</em> installing SafeNet® Sentinel™ security key drivers remove all Sentinel USB keys from the PC. If a system driver is installed with a USB key in the port, the key may become unusable.</td>
</tr>
</tbody>
</table>
CinePlex®
Behavioral Research System
User Guide

Document Number: CPXMN0001c
Document Status: Standard
Version: 3
Date: September 2014

This Guide is for use in conjunction with a CinePlex System integrated with an OmniPlex® System

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Publication History

September 2014

This document release provides a substantial update for Version 3 of the Plexon®
CinePlex® Behavioral Research System, including CinePlex Studio, Editor,
Tracking Option, Basic Behavior Option and 3D Option. It is based on Version
3.5 of the CinePlex software and is applicable to configurations in which a
CinePlex System is integrated with one of the Plexon OmniPlex® Neural Data
Acquisition Systems (referred to as the CinePlex/OmniPlex System).

The list below highlights some of the recent enhancements to the CinePlex System.

**Studio, Tracking and Basic Behavior**

- The system can read a wider range of MJPEG files in offline mode, including
  [1] files with either mjpg or ffds signatures and [2] files of varying resolutions
  if both the frame width and frame height are multiples of 16. See Section 1.6,
  “CinePlex Studio Features” on page 5.

- The system allows you to connect up to four cameras and record four videos
  simultaneously during an experiment. The image for each camera can be
  calibrated independently (inch/pixel or cm/pixel). See Section 3.1, “Setting
  Up Cameras and the User Interface” on page 26.

- The user-specified path to the Recording folder is now saved in the Settings
  file. See Section 3.4.1, “Recording Procedure” on page 42.

- The Extractor function in CinePlex Editor creates data files in comma-
  separated-values (CSV) format, which open directly in Microsoft® Excel® or
  Notepad. See Section 3.9, “Using the Extractor” on page 70.

- The configuration pane previously labeled Areas is now labeled Scenes. See
  Section 5.5, “Defining the Arenas” on page 152 and Section 6.6, “Adding
  Zones (Static and Dynamic)” on page 211.

- The behavioral events conditions Entering Zone and Exiting Zone have been
  replaced with the conditions Present in Zone and Absent from Zone. See
  Section 6.8.1, “Events Based on a Zone” on page 220.

- Speed measurements and events are supported for up to four cameras. See
  Section 6.8.4, “Events Based on Speed” on page 225.
Editor

- The Editor feature has been updated to include the detection of animal freezing behavior. See Section 4.6.1, “Using the Freezing Detector” on page 119.

- The Editor graphical user interface (GUI) has been enhanced for ease of use.

Important—Scope of this document

This document covers CinePlex Systems that are integrated and synchronized with a Plexon OmniPlex System. This integrated configuration is referred to as the CinePlex/OmniPlex System. Other CinePlex System configurations are available from Plexon (see Section 1.1, “Scope of this User Guide” on page 2), but those configurations are not in the scope of this user guide.

April 2013

This document is a substantial update for Version 3.4 of CinePlex Studio and the CinePlex Tracking Option.

Note: The preliminary version of this document is intended for use during the Plexon Workshop conducted in Dallas, Texas, in April/May 2013.

February 2010

Document Version 3.0 is a complete rewrite for versions 3.0 of CinePlex Studio and CinePlex Editor.

February 2008

Document Version 2.0 is a complete rewrite for software versions 2.0 of CinePlex Studio and CinePlex Editor.

March 2007

Document Version 1.4 adds new user interface features, menu items, screenshots, and updates for CinePlex Studio text and CinePlex Editor text as well as additions and modifications to the appendices.

August 2006

Document Version 1.3 adds new features, menu items, screenshots, and minor updates to text.

December 2005

Document Version 1.2 adds new menu items, new snap-to capability, a control for continuous channel loading, and other minor changes.

May 2005

Document Version 1.1 adds Recorder functionality.

March 2005

Version 1.0 is the first release of CinePlex.
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1 CinePlex System Applications and Features

1.1 Scope of this User Guide

The scope of this user guide is the Plexon® CinePlex® Behavioral Research System (CinePlex System) integrated and synchronized with any Plexon OmniPlex® Neural Data Acquisition System (OmniPlex System). This integrated configuration is referred to as the CinePlex/OmniPlex System in this user guide.

Summary of Additional CinePlex System Configuration Options

Other CinePlex System configurations are available from Plexon, but these configurations are not in the scope of this user guide:

• CinePlex System supplied with the Plexon Multichannel Acquisition Processor (MAP) System.
• CinePlex System supplied with a third-party neural data acquisition (NDAQ) system.
• CinePlex System supplied in the standalone configuration (without an NDAQ system).

Note: The OmniPlex System and the MAP System are both examples of NDAQ systems.

The capabilities of the CinePlex System are the same, regardless of the specific integrated NDAQ system, but some details of installation, data flow, usage and file management vary with different NDAQ models.

1.2 Description and Capabilities of the CinePlex System

The CinePlex System is a video capture (recording), tracking, behavioral, and editing system. Using the CinePlex System and one or more cameras, you can capture and record video in Microsoft® standard Audio Video Interleaved (AVI) format. These files are compatible with Windows® Media Player® and many other media players.

In addition to capturing and recording video, you can also

• Track the location (2D or 3D coordinates) of the animal in each video frame
• Synchronize the captured video frames with simultaneously recorded neural data files
• Play the synchronized video and neural data recordings
• Add behavioral event markers and signals
• Add time-interval variables
• Export the marked-up data from the CinePlex System for further analyses by other programs
The CinePlex System allows rapid repositioning of cameras to suit the specific needs of each experiment. After mounting the cameras, you can enter new settings for the repositioned cameras, calibrate the new arenas (if necessary) and proceed with the experiment. In many cases, this repositioning process and resetting of parameters can be accomplished in a few minutes per camera.

1.3 Experiment Design Requirements

The CinePlex System features and options described in this chapter meet the requirements of a wide range of experiment designs. If assistance is needed in determining whether the CinePlex System is applicable to a particular experimental design, please contact Plexon at +1-214-369-4957 or support@plexon.com.

Examples of special experiment design requirements include the following. Contact Plexon for available options.

- The experiment requires tracking an animal in the dark.
- Multiple animals of the same color must be tracked.
- The experiment requires tracking objects that move faster than can be resolved at 200 frames per second.
- Tracking multiple spots on an animal is desired, but there is no way to apply colors (as with a fish, for example).
- The camera cannot be positioned to record the animal in the region of interest (in a tunnel maze, for example).
- The ratio of the size of the trackable arena to the size of the animal is such that the animal’s image is too small or too large to be tracked.
1 CinePlex System Applications and Features

1.4 Overview of CinePlex System Features and Functions

This section describes the video capture, recording and file processing features of the CinePlex System core components (CinePlex Studio and CinePlex Editor) and options (CinePlex Tracking, CinePlex Basic Behavior and CinePlex 3D). This information assists the experimenter in selecting the components and options to use for his or her experiments. The figure below provides an overview of the CinePlex System functions.

The CinePlex System options can be deployed in any of the combinations listed below. The experimenter may select and purchase the combination that meets the needs of the experiments to be performed. Note that the Tracking Option is an extension built on top of the core functions (Studio and Editor). The Basic Behavior Option and 3D Option are extensions built on top of the Tracking Option.

- Video recording and editing - Studio + Editor
- Video recording, editing and tracking - Studio + Editor + Tracking Option
- Video recording, editing, tracking and behavior monitoring - Studio + Editor + Tracking Option + Basic Behavior Option
- Video recording, editing and tracking in 3 dimensions - Studio + Editor + Tracking Option + 3D Option
- Video recording, editing, tracking in 3 dimensions and behavior monitoring - Studio + Editor + Tracking Option + 3D Option + Basic Behavior Option
Note: The 3D Option is described in this chapter, but detailed procedures are not within the scope of this document. Information about the 3D Option is available directly from Plexon.

1.5 CinePlex Licensing Options

The table below shows the CinePlex System licenses and how they can be combined. You can view the list of licenses installed on your system by selecting About from the Help dropdown list then clicking on the Licensing button.

<table>
<thead>
<tr>
<th>CinePlex Applications Required</th>
<th>License(s) Required</th>
<th>Label on USB Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studio and Editor</td>
<td>CPX V3</td>
<td>CPX v3</td>
</tr>
<tr>
<td>Studio and Editor + Tracking Option</td>
<td>CPX V3</td>
<td>CPX-T v3</td>
</tr>
<tr>
<td></td>
<td>CPT V3</td>
<td></td>
</tr>
<tr>
<td>Studio and Editor + Tracking Option + Basic Behavior Option</td>
<td>CPX V3</td>
<td>CPX-T-B v3</td>
</tr>
<tr>
<td></td>
<td>CPT V3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CPB V3</td>
<td></td>
</tr>
<tr>
<td>Studio and Editor + Tracking Option + 3D Option</td>
<td>CPX V3</td>
<td>CPX-T-3D v3</td>
</tr>
<tr>
<td></td>
<td>CPT V3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3D</td>
<td></td>
</tr>
<tr>
<td>Studio and Editor + Tracking Option + 3D Option + Basic Behavior Option</td>
<td>CPX V3</td>
<td>CPX-T-B-3D v3</td>
</tr>
<tr>
<td></td>
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<td>3D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CPB V3</td>
<td></td>
</tr>
</tbody>
</table>

It is acceptable to have some CinePlex System options installed but not used in a particular experiment. The screen will display all of the optional functions, but they will not affect the performance of the other options.

Each CinePlex System license can be configured (optionally) to handle up to four cameras.

1.6 CinePlex Studio Features

CinePlex Studio consists of hardware and software that support capturing, digital video recording (DVR) and playing back the video. CinePlex Studio software, along with the specified hardware and at least one FireWire camera and lens, provides the features and functions described in this section.

- General features and functions
  - CinePlex Studio is a normal Windows application (Windows 7 and Windows XP)
1 CinePlex System Applications and Features

— CinePlex Studio runs in online mode on the computer supplied by Plexon as part of the CinePlex/OmniPlex System

— CinePlex Studio can run on many standalone Windows computers in “File” (offline) mode (i.e., analyzing files originally produced by the PC to which cameras are connected)

**Note:** The standalone computer must have minimum memory, processor and instruction set to run CinePlex Studio efficiently. The requirements for the computer are summarized in Section 1.13.2, “Processing and Analyzing Data” on page 14.

— In combination with the Plexon OmniPlex System, the CinePlex System functions can be synchronized with neural data recording

— CinePlex Studio hardware, when supplied as part of a CinePlex/OmniPlex System, consists of
  
  — A host PC, which runs the CinePlex Studio software and the associated Plexon OmniPlex System software
  
  — One or two monitors to display the CinePlex Studio and OmniPlex System user interfaces
  
  — A keyboard to allow user input such as file names
  
  — A mouse, to control the CinePlex Studio and OmniPlex System software
  
  — Associated cables and special CinePlex System hardware items

• Video

  — Provides a video capture capability, which can be synchronized with neural recordings from the OmniPlex System

  — Produces standard video AVI files in MPEG format

  — Allows an essentially unlimited AVI file size (Microsoft extension to NTFS format eliminates the 4 GB file size limit)

  — Timestamps frames with the corresponding OmniPlex System times.

  — Generates video file names that correspond to names given to synchronized neural data files

  — Allows user-specified prefixes for filenames when recording non-synchronized files

  — Enables you to select image quality and file sizes in recordings by changing the nominal bit rate

  — Records directly to an internal hard drive
— Supports digital imaging with up to four AVT Stingray cameras (640 x 480 and 320 x 240 customer-selectable resolution) at up to 80 frames per second on each camera
— Supports digital imaging with one or two AVT Pike cameras (640 x 480 and 320 x 240 customer-selectable resolution) at up to 200 frames per second on each camera
— Supports digital imaging with one AVT Pike high-resolution camera (960 x 960, 640 x 640 and 320 x 320 customer-selectable resolution) at up to 60 frames per second
— Supports near IR (infrared) recording and tracking (optionally available)

• Offline computation and/or extraction of selected static and dynamic data from CinePlex System video files
  — Reads MPEG files created by CinePlex System Version 3
  — Reads MJPEG files created by CinePlex System Version 1 or 2
  — Reads certain MJPEG files that were originally created by tools not supplied by Plexon, for example, files with either “mjpg” or “ffds” signatures
  — Reads MJPEG files of varying resolution if both the frame width and frame height are multiples of 16
  — Allows re-recording of MJPEG files in the more efficient MPEG format resulting in file size reductions of up to 90%
  — Allows selection of a time range or all of the file to be extracted
  — Generates output files with user-selected content and format (for example, tab or comma delimited format or text)

1.7 CinePlex Editor Features
CinePlex Editor provides a software tool set with which you can view and edit video and neural data files together. You can view time-correlated video, neural, and positional data, add and edit annotations, and perform other operations on the data, such as artifact removal. CinePlex Editor records user actions to its own separate CinePlex project file, so you can continue annotation and editing work over several sessions. When the markup process is completed, you can save the results and export the data for further analysis.

CinePlex Editor includes the features and functions described below.

• Viewing of Plexon MPEG or MJPEG files
  — Provides digital video playback capabilities
  — Allows integrated viewing of neural data files (Plexon PLX files, NEX files) and AVI files

Version 3 7
1 CinePlex System Applications and Features

— Visualizes tracking position data (if any) overlaid on video
— Seeks and searches files based on neural data and manual event markers

• Editing
— Allows you to insert video-aided event markers and intervals
— Allows you to remove temporal segments of neural data during artifact-generating behaviors (chewing, grooming, etc.)
— Allows you to enter position coordinate data
— Allows you to edit position coordinate data created by CinePlex Editor or Studio
— Provides the ability to play a sound (standard or user-selected) when event markers or neural spikes occur during playback
— Supports the Microsoft extension to NTFS file format to be able to utilize AVI files larger than 4GB
— Provides the ability to save neural data to Plexon PLX files and NeuroExplorer® NEX files, or export to text or comma-separated-values (CSV) file. Text and CSV files can be opened in applications such as Excel® or MATLAB® for additional analysis.

1.8 CinePlex Tracking Option Features

CinePlex Tracking Option extends the capabilities of CinePlex Studio. It provides arena definition and automated tracking of an animal’s movement and position over time. This option supports both real-time and offline tracking capability.

• Provides the option of calibrating the video and tracking data in inches or centimeters
• Features Smart Tracking that uses robust algorithms for LED tracking, object contour tracking, and reflective color tracking
• Allows tracking of up to 12 markers of different colors from up to four video streams
• Uses strobed word format to deliver tracking coordinates directly to the data buffer used by the OmniPlex System
• Analyzes each frame of video data to determine the positions of the objects being tracked, and timestamps and saves the data to files on the host PC. One or both of the following file types can be chosen:
  — Video format (AVI)
  — Digital video tracking (DVT) text format
• Analyzes contour motion across adjacent video frames, and generates data that experimenters can use to detect “freezing” in an animal’s movements, as might be used in fear-conditioning experiments.

1.9 CinePlex Basic Behavior Option Features

CinePlex Basic Behavior Option extends the capabilities of the Tracking Option and includes the following features for behavioral analysis and digital events marking:

• Allows user to define static and dynamic zones of interest within an experimental arena
• Allows you to define zone sequences
• Monitors objects traversing zones and sequences to generate logical and digital events
• Allows user to define behavioral events from one or multiple cameras to generate logical and digital events
• Provides real-time and offline information about behavioral events and tracked objects, including such attributes as speed, direction (vector), limb angles, presence in particular zones in the arena, proximity to other objects, sequence of zones visited, and many similar metrics.
• Monitors vectors between objects to create behavioral events when within/outside of a customer-defined angle and tolerance
• Monitors animal head direction based on markers or LEDs on a headstage.
• Monitors animal speeds to create digital events when over/under a user-specified threshold
• Accumulates and displays behavioral event statistics
• Allows you to specify up to 24 digital outputs to be generated when specific behavioral events occur in the arena

Note: Digital outputs are available for external devices when the digital output (DO) unit (included with the Basic Behavior Option) is attached to a USB port on the CinePlex System PC. The digital outputs can be pulsed, high, or low when the event occurs (that is, when the event becomes TRUE).

1.10 CinePlex 3D Option Features

CinePlex 3D Option extends the capabilities of the Tracking Option and includes the following features for three-dimensional tracking and analysis:

• Allows tracking of up to 12 markers of different colors from up to four video streams in three dimensions
• Allows tracking of LEDs in three dimensions
1 CinePlex System Applications and Features

- Permits three-dimensional reconstructions both online and from files
- Includes an embedded calibration function that does not require complex measuring between cameras and points in the experimental area
- Allows cameras to be moved and then recalibrated in a few minutes

Note: The 3D Option is described in this chapter, but detailed procedures are not within the scope of this document. Information about the 3D Option is available directly from Plexon.

1.11 CinePlex Combined Basic Behavior Option and 3D Option

The CinePlex Basic Behavior Option and CinePlex 3D Option can both be installed and operating simultaneously along with the required CinePlex Tracking Option.
1.12 System Architecture and Components

This section describes the architecture and components of the CinePlex/OmniPlex System.

1.12.1 CinePlex System in Synchronous Operation with OmniPlex System

The following illustration shows the basic system architecture. The OmniPlex System provides a 1 MHz clock signal that enables CinePlex Studio to timestamp each video frame with a synchronized time.

CinePlex Studio resides on the host PC. CinePlex Studio receives the raw video from the camera, compresses it, and stores it as an AVI file on an internal hard drive of the host PC.

A timing cable connects the OmniPlex System timing interface with the CinePlex System digital input/output (DIO) interface. Through this cable, the OmniPlex System signals the CinePlex Studio computer to start, stop, pause, and resume recording video to AVI files.

The digital output (DO) unit, included with the Basic Behavior Option, connects to a USB port on the host PC and permits the Basic Behavior Option (if installed) to transmit digital outputs to external devices.

The optional analog/digital (A/D) card receives field potential inputs.
1.12.2 Hardware and Software Components

The following illustration shows the major hardware and software components of the CinePlex/OmniPlex System.

The components function as follows:

- OmniPlex System controls CinePlex Studio.
- CinePlex Studio controls the camera(s) and receives video from the camera(s).
- CinePlex Studio writes AVI files (and, optionally, DVT or DV3 files) to file storage and sends coordinate data to the circular buffer where the data is read by PlexControl (the OmniPlex System control application). The CinePlex System can also send coordinate data directly to the OmniPlex System via a software interface (controlled by an option in the Studio user interface).
- The circular buffer receives coordinate data from Studio and neural data from the OmniPlex System server.
- PlexControl writes PL2 (default) or PLX files, which contain both neural data and coordinate data, to file storage.
- CinePlex Editor reads/writes PLX and AVI files from/to file storage.
- NeuroExplorer reads PL2 or PLX files from file storage and writes NEX files.
**Note:** Coordinate data is generated and transmitted only if the Tracking Option is installed on the CinePlex System.

**Note:** Digital outputs (referred to in the above drawing) are associated with behavioral events, and are generated only if the Basic Behavior Option is installed.

### 1.13 Data Flow, File Processing and Analysis

This section describes the flow of data in the system, and discusses methods that can be used for file processing and data analysis.

#### 1.13.1 System Data Flow

The following illustration shows the data flow in a CinePlex/OmniPlex System.

![Data Flow Diagram]

The data flow proceeds as follows:

- If you have selected the AVI checkbox in the digital video recording (DVR) area of the Camera 1 Sources pane, CinePlex Studio writes AVI files directly to file storage. These AVI files have static headers, time-stamped video frames, and dynamic coordinate and event data.

  **Note:** Coordinate and event data are generated and transmitted only if the Tracking Option and Basic Behavior Option, respectively, are installed on the CinePlex System.

- If you have selected the digital video tracking (DVT) checkbox in the DVR area of the Camera 1 Sources pane, CinePlex Studio writes DVT files containing dynamic coordinate data directly to file storage. If the CinePlex 3D Option is installed and active, DV3 coordinate data files are also written to file storage.

- CinePlex Studio sends selected event data and coordinate data to the circular buffer which, in turn, sends the data to PlexControl. PlexControl writes PL2 (default) or PLX files containing neural and CinePlex data to file storage.
1.13.2 Processing and Analyzing Data

After a recording session, you may perform data analysis on the host PC or transfer the files to a different computer (on which CinePlex Studio and/or CinePlexEditor are installed) for analysis.

**Note:** The standalone computer must have minimum memory, processor and instruction set to run CinePlex Studio efficiently. These requirements for offline operation are CinePlex System Version 3 software and a license key that enables the desired capability. However, it is important to determine that the computer on which the installation will be done meets the minimum system requirements. In general, this means a computer has a dual core Intel processor operating at better than 3 GHz with 3 GB of memory, and a NVIDIA® GeForce® 9600 GT or better video card. Requirements that are more current are available from Plexon support ([support@plexon.com](mailto:support@plexon.com)).

With all files and software accessible on a single computer, you can process and analyze the data as follows:

- Use CinePlex Studio in “Files” (offline) mode to rerecord and retrack the original video data.

  If the CinePlex Tracking Option, Basic Behavior Option and/or 3D Option are also installed, additional data manipulation can be performed, depending on the Option(s) installed. Examples of data manipulation include new or changed positional coordinate options, new or changed arenas, zones, and logical events.

- Use CinePlex Editor for simultaneously viewing, annotating, and processing the video, neural data, and position data.

  CinePlex Editor enables you to add and edit annotations and perform other operations on the data, such as artifact removal. When you complete the markup process, the results can be saved back into PLX files, or exported into text or CSV files. Text and CSV files can be opened in applications such as Excel or MATLAB for additional analysis.

- You can spike sort the data with Offline Sorter™, or analyze it with NeuroExplorer for place cell analysis, and save the results of this processing to another PLX file or to a NEX file. For more information on Offline Sorter and NeuroExplorer, go to [www.plexon.com](http://www.plexon.com).
Chapter 2
Installing, Starting and Testing CinePlex Studio

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2 Installing, Starting and Testing CinePlex Studio

2.1 Installing the CinePlex System

If the CinePlex® System hardware has not yet been cabled, perform the necessary procedures. See Appendix A, Cabling Guide.

In most cases, the CinePlex System software has already been installed by Plexon®.

If assistance is needed, contact Plexon support at +1-214-369-4957 or support@plexon.com.

**CAUTION**

Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.
2.2 Startup and Operational Testing

The starting sequence for a synchronized CinePlex/OmniPlex® System is important for correct operation of CinePlex. If the correct sequence is not followed, video might not be visible or it might not be possible to control and synchronize the CinePlex System with OmniPlex System.

**Startup**

The startup sequence is extremely important. OmniPlex must be started before Studio is started so that the client registration process works properly. Otherwise, when a recording is eventually started by OmniPlex, neither the file name string nor the recording time messages are received.

If the OmniPlex System exits or is closed for any reason, it should be brought back up, then Studio should be closed and restarted, as well.

Follow these steps to start the system and perform an operational test.

1. Power up the computer (Host PC) and log in.
2. Plug in the SafeNet® Sentinel™ license (USB key drive) into any USB port on the computer.
   
   **Note:** Both the OmniPlex and CinePlex licenses must be present.
3. Turn on power to the OmniPlex System chassis.
4. Start the OmniPlex Server program and verify that there are no errors. The easiest way is to double-click the **OmniPlex Server** desktop icon.

   If there are no problems, the OmniPlex Server main window appears.
5 Start the PlexControl program and verify that there are no errors. The easiest way is to double-click the PlexControl desktop icon.

The PlexControl window displays.
6 Press the **Start Data** button on PlexControl toolbar. (This starts the OmniPlex System 1 MHz clock.)

7 Wait to ensure that the system is attempting to collect neural data. (Typically, at this stage, there is no neural data input, but the system Messages pane should report that it is collecting data - "Data Starting." If the Message pane does not have the "Data Starting" message, refer to the OmniPlex System instructions.

8 Start CinePlex Studio program. The easiest way is to double-click the **CinePlex Studio** desktop icon.

9 View the monitor to see if the CinePlex Studio main window displays. If Camera 1 is active, the video should be displayed in the Video 1 window. (It is acceptable if multiple cameras are active. For example, in the image below, Camera 1 and Camera 2 are both active.)
10 If the CinePlex Studio main window displays with video, as shown in the example in Step 9 (and Camera 1 is active), skip to Step 12. Otherwise, perform Step 11.

11 If the error window is displayed as shown below, it means that one of the following problems has occurred:

- The Timing cable is not connected correctly from the OmniPlex System to the Host PC.
- The Start Data button has not been pressed.
- The Trigger or FireWire cables are not connected between the host PC and the camera.
• The camera is in an error state.

Take the necessary action:

• Connect the Timing cable.

• If the **Start Data** button has not been pressed, press it now.

• If the Trigger or FireWire cables are not connected, shut down the computer and connect those cables now. Then restart the computer.

• If the camera is in an error state, cycle the power: Use the Windows® function to restart the host PC. Then perform Step 4 through Step 10 again.

12 Select **Cameras** mode (from the dropdown menu shown below), if not already selected. Video should now be displayed on the Video 1 window.

13 If proper video is observed at the monitor, it is reasonable to assume the camera, computer, and monitor are working correctly.

14 If there is no video, perform the following steps:

• If the **Camera 1** icon background (to the right of the **Cameras** dropdown) is *not* orange, it is not selected. Click on this icon now to select it. Ensure that the background changes to orange.

• Check the cabling, connections, AC power, on/off switches, lighting, and the iris, zoom, and focus of the camera.

The cables might not be connected properly, one or more cables might be broken internally, a pin or pins on a cable could be bent or broken, the iris
on the camera could be shut, the zoom on the camera could be set improperly, or the focus could be set so that everything is a blur.

**CAUTION**
Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.

**TIP**
**Video Test Mode**
Video Test Mode enables the experimenter to verify operation of the video portion of the experimental setup without having to activate and connect the OmniPlex System. The license keys normally required must be present on the computer. For the detailed procedure, see Video Test Mode on page 2-23.
2.3 Video Test Mode

Video test mode is provided to enable the experimenter to verify operation of the video portion of their experimental setup without having to activate and connect the OmniPlex System, prepare animals for recording, connect preamplifiers, etc. The license keys normally required must be present on the computer.

When CinePlex Studio starts, it checks for the presence of the Access IO board. If the AccessIO board is present, Studio checks for the clock signal from the OmniPlex System.

If the AccessIO board is not present or if there is no clock signal from the OmniPlex System, the following message displays if one or more cameras are detected. Otherwise Studio opens in File mode without showing the message.

Note: The dialog box text refers to the OmniPlex System as the Plexon Neural Data Acquisition (NDAQ) system.

After the OK button is pressed, the following window is displayed:

CinePlex Studio

C900 CLOCK SIGNAL FROM PLEXON NDAQ SYSTEM NOT DETECTED!
Please check connection between Plexon NDAQ system and CinePlex.
Be sure that data acquisition is started.
CinePlex requires an incoming 1 MHz clock signal to provide trigger pulses for video camera(s).
This clock signal is supplied by a Plexon NDAQ system.
When the problem is corrected, you will need to restart CinePlex Studio.
For more information, please see the CinePlex Manual - Appendix D.
If you continue to have difficulties, please contact Plexon at support@plexon.com

After the OK button is pressed, the following window is displayed:

CinePlex Studio

C944 No clock signal from Plexon NDAQ system, but cameras are detected.
Switch to test mode? Clicking YES will switch Studio to the test mode. Otherwise Studio will start in File mode.

[Yes] [No]
Click **Yes** to enter Test mode or **No** to enter File mode.

Test mode has several restrictions compared to the normal mode:

- The CinePlex System switches cameras to free-running mode (using their internal trigger), since there is no external trigger available.
- The **Arm** button (the red circular button with the letter “A” in the main toolbar) is disabled, since it is impossible to sync with the OmniPlex System.
- Recording can be done only by pressing the **Record** button on the toolbar.
- The duration of each recording is restricted to 1 min.
Chapter 3
Recording Video with CinePlex Studio

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3 Recording Video with CinePlex Studio

3.1 Setting Up Cameras and the User Interface

3.1.1 Positioning the Cameras and Verifying Video Quality

1 Ensure that Cameras is selected in the video source dropdown list on the main toolbar. Camera setting options do not display in the main window unless Cameras is set in the main toolbar. If only two cameras are installed, the toolbar would display two camera icons, as shown in the image below.

If it is not possible to select Cameras, Studio has not detected any attached cameras. See Appendix F, Troubleshooting for troubleshooting this problem.

Note: If there are two or more cameras, the system will automatically assign the camera with the lowest serial number to be Camera 1. If there is only one camera, it is Camera 1.

TIP
Consider calibration requirements
Plan the mounting of cameras with calibration in mind. Calibration of linear dimensions (in inches or centimeters) only works accurately when the camera is orthogonal to the arena.

Each of the arenas (that is, the arenas for Cameras 1, 2, 3 and/or 4) can be calibrated independently.

The calibration procedure is explained in Section 3.3, “Calibrating the Arena Dimensions” on page 30.

2 Select the icon(s) for the camera(s) to be used in the experiment (up to four cameras). A camera is active only if the corresponding icon is selected. The orange color in the icon indicates a camera is selected.

In the image in Step 1 above, the orange color on the Camera 1 icon shows that Camera 1 is active, and it can also be seen that Camera 2 is inactive. Clicking on the Camera 2 icon will make it active also, as shown in the image below.

3 Read Appendix B, Optimizing Camera and Lens Usage for the Experiment, to understand the detailed requirements for camera mounting, cabling and
removal. This information is essential for positioning the camera(s) and obtaining the best results from the CinePlex® System.

**CAUTION**

Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.

4 Set up one of the cameras as described in Appendix B. It is typical to set up Camera 1 first and mount it orthogonally to the arena.

**TIP**

**Ensure that cameras are set up for optimum imaging**

In general, it is best to position the camera as far from the experiment as possible, then zoom as much as possible in order to fill the field of view with the area of interest without distortion. Appendix B, explains how to compute the distance from the camera to the arena so that the whole arena is visible.

5 Obtain an initial video image from the camera using the default CinePlex Studio settings and changing only the physical adjustments (iris, focus and zoom) on the camera lens.

**Note:** The settings that are available on a particular lens depend on the lens make and model. Not all settings are available on all models.

6 If any attached camera experiences either of the following problems, take the action recommended here:

   a If there is no Source window pane corresponding to the camera, go to the **Window/Layout** pulldown menu and select **Reset to Default Layout**.

   a If there is a Source window pane corresponding to the camera, but no video is displayed there, select the camera icon in the toolbar to make the camera active. (For example, see the camera icons in the image below. In that image, the icon for **Camera 2** has not been selected, and therefore **Camera 2** is not yet active.)
3 Recording Video with CinePlex Studio

TIP
Make the Video Image Larger
If the default video image is not large enough to make your desired adjustments, drag the video window out of its frame to another area on the monitor. Then adjust the window size in the normal way.

1 If the previous steps do not result in a good image on the camera, manually change camera settings in CinePlex Studio. The available settings depend on the camera model. Typically, the settings should be adjusted in this order: Contrast, Brightness, Sharpness, and Saturation.

2 If the above steps do not cause the video to appear, refer to Appendix F-Troubleshooting.

3 Repeat Step 4 through Step 2 for each additional camera that will be used in the experiment.

TIP
Video Test Mode
Video Test Mode enables the experimenter to verify operation of the video portion of the experimental setup without having to activate and connect the OmniPlex® System. The license keys normally required must be present on the computer. For the detailed procedure, see Video Test Mode on page 23.

4 Calibrate the dimensions in the video field. (Calibration is accurate only when the camera is positioned orthogonally to the arena.)

Note: In many experiments, it is useful to calibrate the video image dimensions so that the ratio of centimeters to pixels (or inches to pixels) is known. The calibration ratio can be useful even if the Tracking Option is not currently installed, because the tracking data can be processed with the calibration data at a later time (if the Tracking Option is purchased). For the procedure, see Section 3.3, "Calibrating the Arena Dimensions" on page 30.

3.1.2 Arranging CinePlex Studio Windows
The default window layout will be sufficient for many experiments. However, to change the window layout, see Appendix E, Navigating the Plexon User Interface.

To load or save a layout configuration, see "Window Menu" in Appendix E.
3.2 Navigating the Studio Main Window

This section describes the CinePlex Studio main window, where you can view and modify Studio settings before starting the recording session.

This drawing shows the location of the panes in the CinePlex Studio main window. In this example, there are two cameras connected; up to four cameras can be licensed (optional).

**TIP**

Verify “Cameras” Is Selected

Camera settings do not display in the main window unless **Cameras** is set in the main toolbar.
3 Recording Video with CinePlex Studio

3.2.1 Main Toolbar Icons

The image below shows a close-up view of the CinePlex Studio main toolbar. In this example, there are four cameras connected and three of them are active.

3.2.2 Global Configuration Pane Settings

This pane (see the image above) is the first an experimenter will normally use when setting up CinePlex Studio, but perhaps not very often after that. It contains settings that pertain to the frame rate to use when recording, image resolution (quality of recordings to make), compression bit rate, and local file recording folder. For information about video formats and the video Quality setting, see Section 3.10.2, “MPEG-4 Quality and File Size” on page 79.

3.2.3 Source Pane Settings

This pane is the second an experimenter will normally use when setting up CinePlex Studio. There can be multiple Source panes if there are multiple cameras on the system. This pane contains parameters that relate to optical settings for each camera (contrast, brightness, sharpness, saturation, etc.), file output format (AVI or DVT), labeling/timestamping of frames and calibration. (For the calibration procedure, see Calibrating the Arena Dimensions, below.)

3.3 Calibrating the Arena Dimensions

In many experiments, it is useful to calibrate the video images from one or more cameras so that the ratio of centimeters to pixels (or inches to pixels) is known. The calibration ratio can be useful even if the Tracking Option is not currently installed, because the tracking data (such as the animal’s speed) can be processed with the calibration data at a later time (if the Tracking Option is purchased). This section describes how to perform the calibration procedure on an active camera. The calibration procedure can be repeated for any or all active cameras.
Note: Calibration only works accurately when the camera is orthogonal to the arena.

CinePlex Studio provides two methods of calibration - single axis (also called One-Bar) and dual axis (also called Two-Bar).

**Calibration** is the final section of the Source (Video) pane.

**Setting Up the Camera**

The camera should be set up according to the instructions in Section 3.1, “Setting Up Cameras and the User Interface” on page 26.

**Selecting Calibration Units and Type**

1. Open up the **Calibration** section (if it is not already open) by clicking on the “+” sign.

2. Check the box labeled **Use Calibration**. Note that the title of the section changes from **Calibration** to **Calibrated**. This is because the current calibration **Global Factor** is now being applied.

3. Select the unit of measure (**Units**) - either cm for centimeters or in. for inches.

4. Select the method of calibration (**Type**) - either **One-Bar** or **Two-Bar**.

![Calibration and Calibration Units and Type sections](image-url)
3 Recording Video with CinePlex Studio

Setting Calibration Parameters with One-Bar

5 When **One-Bar** has been selected:

a Click the "+" sign next to **Global Factor** and then the "+" next to **Reference Size** to expand their subsections, if needed. If they are already shown as "−" signs, this is not needed.

![Calibration settings](image1)

b If the current color in the box next to the **Color** item will not provide good contrast with the video image, click in the box and select a suitable color. The color selected is the color of the measurement bar used for calibration.

![Calibration settings](image2)

c Choose a feature in the experimental area whose video image extends over much of the field of view. As an illustration, the inside diameter of the clock frame in the image below will be used as the desired dimension.

![Calibration settings](image3)
d. Measure its longest dimension in the units desired, and record it for reference. The inside diameter of the clock frame measured 30.5 cm.

e. Click the **Adjust** button. The cursor will go to the video image and a line will appear in the color selected. Select one end of the colored line and move it to one end of the feature just measured. Select the other end of the line and move it to the other end of the feature.
3 Recording Video with CinePlex Studio

In the image above note the green line through the middle of the clock with the box on each end. This is the sizing bar.

In the above image note that the left end of the sizing bar has been moved to the inside edge of the clock's frame. Select the other end of the sizing bar and move it to the opposite inside edge of the clock frame and ensure the sizing bar crosses the intersection of the clock hands.
In the above image note that the sizing bar now measures the inside diameter of the clock’s frame.

f Right-click to record the length of the bar in pixels.

g Go to the slider next to the Actual item and move it so that it reads the dimension recorded above. Studio is now calibrated to the measured distance. The arrow keys may be used for fine adjustments to the slider positions.

In the image above note that the Actual setting has been changed to the measured inner diameter of the clock’s frame (30.5 cm).

h Click all three “-” signs once the adjustment is satisfactory to hide the adjustments.

i After the parameters are set as desired, on the File menu, click Save Settings, or click the Save Settings button ( ) on the toolbar.

Setting Calibration Parameters with Two-Bar

6 When Two-Bar has been selected:

a Click the “+” sign next to Horizontal Factor and then the “+” next to Reference Size to expand their subsections, if needed. If they are already shown as “-” signs, this is not needed.
b. If the current color in the box next to the Color item will not provide good contrast with the video image, click in the box and select a suitable color.

c. Choose a horizontal feature (horizontal relative to the video image) in the experimental area whose video image extends over much of the field of view. Once again the inner diameter of the clock’s frame will be used.
d Measure the feature’s horizontal dimension in the units desired, and record it for reference. The inner diameter is 30.5 cm.

e Click the Adjust button in the Horizontal section. The cursor will go to the video image and a horizontal line will appear in the color selected.

In the image above note the green line through the middle of the clock with the box on each end. This is the sizing bar.

f Select the horizontal sizing bar and move it vertically so that it rests on the desired feature in the frame (in this example, it will be moved to the intersection of the clock hands at the center of the clock). Select one end of the sizing bar and move it over the desired feature in the image. Repeat this process for the other end of the sizing bar. In this example, the ends of the sizing bar will be placed at the inside edges of the clock frame.
3 Recording Video with CinePlex Studio

In the above image note that the sizing bar now measures the inside diameter of the clock’s frame.

g Right-click to record the length of the bar in pixels.

h Go to the slider next to the Horizontal Actual item and move it so that it reads the dimension recorded above.

i Click the "+" sign next to the Vertical Factor and then the "+" next to Reference Size to expand their subsections, if needed. If they are already shown as "-" signs, this is not needed.
j If the current color in the box next to the **Color** item will not provide good contrast with the video image, click in the box and select a suitable color.

k Choose a vertical feature (vertical relative to the video image) in the experimental area whose video image extends over much of the field of view. Once again the inner diameter of the clock’s frame will be measured.
3 Recording Video with CinePlex Studio

l Measure the feature’s vertical dimension in the units desired, and record it for reference. The inner diameter of the clock’s frame is 30.5 cm.

m Click the Adjust button in the Vertical section. The cursor will go to the video image and a line will appear in the color selected.

In the image above note the vertical green line with a box at each end. This line is the sizing bar.

n Select the vertical sizing bar and move it horizontally so that it rests on the desired feature in the frame (in this example, it will be moved to the intersection of the clock hands at the center of the clock). Select one end of the sizing bar and move it over the desired feature in the image. Repeat this process for the other end of the sizing bar. In this example, the ends of the sizing bar will be placed at the inside edges of the clock frame.
In the image above the bottom of the sizing bar has been set within the clock frame.

- Right-click to record the length of the bar in pixels.

- Go to the slider next to the **Vertical Actual** item and move it so that it reads the dimension recorded above (30.5 cm).

Now Studio has been calibrated in both horizontal and vertical directions.

- Click all five “-” signs once the adjustments are satisfactory to hide the adjustments.

- After the parameters are set as desired, on the **File** menu, click **Save Settings**, or click the **Save Settings** button ( ) on the toolbar.
3 Recording Video with CinePlex Studio

3.4 Recording Synchronized Video Tracking and Neural Data

This section explains how to record video and tracking data that is synchronized with neural data from the OmniPlex System. This procedure requires starting and stopping the CinePlex Studio video recording process remotely from the OmniPlex System. This method of triggering the recording ensures that:

- The timestamps in the CinePlex and OmniPlex files are derived from the same clock
- The CinePlex and OmniPlex file start times and stop times are synchronized
- The CinePlex frame numbers and timestamps are synchronized

Simultaneous starting, stopping, pausing, and resuming of the neural data and video files is essential in helping the researcher correlate the behaviors captured in the video with the observed neural activity.

Although you can manually start, stop, pause, and resume recording an AVI file at any time in CinePlex Studio by simply clicking the appropriate toolbar buttons, this method will not record synchronized files, because it produces video files that do not have the same start time as the corresponding neural data files.

**Note:** If the animal is being trained prior to the collection of neural data, the CinePlex System can record AVI and/or DVT files without the existence of neural data files. In that case, OmniPlex is used only as a clock source for the CinePlex System. The procedure for that case is provided in Section 3.6, “Recording Video without Neural Data (Used for Animal Training)” on page 3-52.

3.4.1 Recording Procedure

Perform these steps to record synchronized video and neural data.

The steps must be followed in the sequence listed here. If they are not performed in order, it will not be possible to create a synchronized recording of video and neural data.

**CAUTION**

Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.

**CAUTION**

Lighting Conditions

If lighting conditions change enough during recording that ‘objects too large’ or some other condition occurs, the position data may be meaningless.
1. Ensure that the system is connected as described in Chapter 2, Installing, Starting and Testing CinePlex Studio.

2. At the OmniPlex System chassis, turn the power on and start the OmniPlex Server and PlexControl.

3. If not already done, configure the OmniPlex System.

4. Click the Start Data button in the PlexControl toolbar so that neural data acquisition begins, and the neural data appears in PlexControl display.

5. Double-click the CinePlex Studio icon. Wait for the CinePlex Studio application main window to appear on the monitor.

   **Note:** If Studio does not detect the OmniPlex clock, an error message will appear. If it does, see Appendix F-Troubleshooting.

6. Verify that Cameras is selected in the Studio dropdown list and that a camera image is displayed for each of the camera(s) that will be used in the experiment. The image is displayed for each camera icon that is selected. The image below shows that both Camera 1 and Camera 2 are selected (indicated by the orange color of the icons).

7. If there is an appropriate file containing all the desired CinePlex settings, load the file onto the CinePlex System using the Load Settings icon ( ) on the main toolbar or the File/Load Settings menu selection.

8. Click on the Global Config tab in the static configuration pane to display the Global Config pane.

   ![Global Config](image)

   **Note:** This pane is the first an experimenter will normally use when setting up CinePlex Studio, but perhaps not very often after that. It contains settings that pertain to the frame rate to use when recording, image resolution (quality of recordings to make), compression bit rate and local file recording folder. For information about video formats and the video Quality setting, see Section 3.10.2, “MPEG-4 Quality and File Size” on page 79.
3 Recording Video with CinePlex Studio

9 View the settings in the Global Config pane and modify any that need to be changed prior to starting the next recording session.

10 To browse for the desired file location (where the recorded files will be saved), click on the browse icon, which is the rectangle with three dots on the Rec Folder row of the Global Config pane.

11 When the Browse For Folder dialog box appears, use standard Windows® methods to select or create the appropriate folder. The factory default location for the Recording folder is C:\PlexonData or D:\PlexonData (if disk D is available).

![Browse For Folder Dialog Box]

12 When finished choosing or creating a storage folder, click OK.  
**Note:** The location of the Recording folder is included in the Settings file (if you save a Settings file), and is restored when the Settings file is loaded. To save settings, click Save Settings on the File menu, or click the Save Settings button ( ) on the toolbar.

**Note:** If the Recording drive is not NTFS compatible, a warning message displays.

13 To view the CinePlex Studio time display, see the Source pane under the Video window. The image below shows the Source 1 pane, which appears under the Video 1 window for Camera 1. Similar panes appear for each of the cameras you have activated in the previous steps. (Calibration is explained in a later step in this procedure.)
In the Camera area of the Source pane (labeled with the camera model name), adjust the controls to obtain an acceptable image on the screen. The specific controls vary depending on the camera model. Typical adjustments include Gain, Auto White Balance, Brightness, Sharpness and Saturation.

**Note:** You can also use other image quality settings. To evaluate image quality settings, manually collect a set of AVI files at different settings and use the file mode to determine a minimum acceptable image quality setting for the experiment. (For information about video formats and the video Quality setting, see Section 3.10.2, “MPEG-4 Quality and File Size” on page 79.)
3 Recording Video with CinePlex Studio

TIP
Reducing blurs and color streaks in the video
If the experimental subject moves quickly, blurs and color streaks can appear in the video. Reduce or eliminate these problems by increasing the shutter speed. See Shutter Speed in the Global Configuration settings, as shown in the image above.

15 In the Sources pane, view the digital video recording (DVR) section.

16 In the digital video recording (DVR) area of the Source pane, select the type(s) of output to create - video file (AVI File), text file with frame numbers and timestamps (DVT File) or both.

<table>
<thead>
<tr>
<th>DVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
</tr>
<tr>
<td>AVI File</td>
</tr>
<tr>
<td>DVT File</td>
</tr>
</tbody>
</table>

CAUTION
Save the AVI File
It is strongly recommended that you save an AVI File for every experimental run, even if you are sending data directly from CinePlex to OmniPlex. (AVI File is the default output type.) The AVI file is the originally recorded video of the experiment, and it can be retrieved and analyzed again. If you deselect the AVI File checkbox, the original video will not be saved.

TIP
Generating timestamps and frame numbers—DVT File
The system will generate a digital video tracking (DVT) file if you select the DVT File checkbox. The DVT file will have frame numbers and timestamps only (no coordinate data). The correlation of timestamps with frame numbers might be useful even without the Tracking Option installed.

17 In the Timecode options, select the In Video checkbox to include the time. Choose a Location and a Format setting to configure the display. (CinePlex
Studio maintains a time code that tracks the time elapsed since the last time recording began.

For example, the following images show the time code in the **Upper Left** location in **SSSSS.SSS** and **HH:MM:SS.SSS** format, respectively.

18 Repeat Step 13 through Step 17 for any other cameras connected to the system.

19 (Optional) If the arena dimensions have not yet been calibrated, the calibration can be done now. See Section 3.3, “Calibrating the Arena Dimensions” on page 30 for details.

20 From the CinePlex Studio toolbar, click the “A” arming button. A yellow flashing cassette icon appears on the status bar.

**Note:** At this point, CinePlex is in the armed condition and is waiting for a start signal to be sent from OmniPlex. The SPK - Activity pane in PlexControl shows no data on the CPX1 line.

21 From the PlexControl toolbar, click the **Start Recording** icon. If PlexControl prompts for a file name, enter it.

PlexControl starts recording and displays status information about the neural data file on the PlexControl status bar; for information on the PlexControl status, see the OmniPlex System instructions.
CinePlex Studio automatically starts recording and displays information about the video file in the CinePlex Studio status bar.

The Studio status bar will display the amount of free space remaining on the drive selected.

**Note:** The system automatically checks that there is at least 10 GB of free disk space on the PC before it starts recording a file. The file size can grow to fill the space available, except that the system automatically stops recording the current file when the available disk space has been reduced to 10 GB.

Studio starts sending the data to OmniPlex, and the SPK - Activity pane in PlexControl shows the synchronized data stream (see the blue data lines in this image):

![Image of SPK - Activity pane showing synchronized data stream]

**Note:** Plexon® recommends a short test recording to verify the data stream is being sent. The SPK - Activity pane in PlexControl should show the presence of the data stream, similar to that shown in the PlexControl image above.

22 To pause recording, click the PlexControl **Pause Recording** icon.

PlexControl pauses recording and displays status information about the neural data file on the PlexControl status bar.

CinePlex Studio pauses recording and displays information about the video file in the CinePlex Studio status bar. The status bar flashes green and gray to indicate that the recording is paused.

To resume recording, click **PlexControl Pause Recording** again.

23 To stop recording, press the **Stop Recording** button in PlexControl (Studio recording stops also.)

PlexControl stops recording to the neural data file, clears the recording information from the status bar, and saves the file as specified in Step 21.

CinePlex Studio stops recording and saves the video file(s) to the location that was specified as **Rec Folder** in the CinePlex Studio Global Configuration Pane. CinePlex Studio clears the recording information from the status bar and re-arms itself for the next recording session.

When Studio is armed, for efficiency it creates temporary files. When recording is started remotely (from OmniPlex), Studio writes to these temporary files. When recording is stopped, the temporary files are renamed, and new temporary files are opened in anticipation of a new recording session. The Studio Messages Pane displays information similar to the example below.
At this point, there is no tracking data being sent from CinePlex to OmniPlex, because CinePlex is once again in the armed condition. The SPK - Activity pane in PlexControl shows no data on the CPX1 line.

You can start and stop recording as many times as desired. When recording starts, data will flow from CinePlex to OmniPlex. When recording stops, data does not flow.

To disarm CinePlex Studio, from the DVR toolbar, click Arm to clear. The status bar returns to the disarmed state.

To view the captured video file, browse to the file location and double click to open the file.

To transfer files to an analysis computer (if different than the recording computer), follow standard Windows procedures.

To view the neural and video files together, start CinePlex Editor by following the procedures described in Chapter 4, Processing Video Files with CinePlex Editor.

You can also view just the video files by using CinePlex Editor, Windows Media Player® or CinePlex Studio on the analysis computer.

### 3.4.2 File Naming Procedure During and After Recording

During the recording process, CinePlex Studio creates temporary names for the AVI files. When the recording is stopped, Studio renames the files.

If there is only one camera connected to the CinePlex System:

- The format of the temporary files is `yyyymmddnnn.avi`
- The format of the renamed files is `PLX_file_name.avi`

If there are multiple cameras connected to the CinePlex System:
• The format of the temporary files is \texttt{yyyyymmddnnn\_N.avi}
• The format of the renamed files is \texttt{PLX\_file\_name\_N.avi}

where:

\begin{itemize}
  \item \texttt{yyyyymmdd} is the year, month and day
  \item \texttt{nnn} is a 3-digit number, 001, 002, ... 999 assigned automatically by the system
  \item \texttt{N} is the camera number for which the file is created - 1, 2, ...
  \item \texttt{PLX\_file\_name} is the file name specified by the user on the OmniPlex System in \texttt{Step 21 of Section 3.4.1, "Recording Procedure" on page 42.}
\end{itemize}

\textbf{Note:} If Studio is armed on one day, but the start signal is not received until the next day, the temporary filename remains the one for the previous day.
3.5 Monitoring the Video During a Recording Session

The status bar in the CinePlex Studio main window displays information that allows the researcher to monitor the video recording process. This drawing shows the status bar during a typical recording session. (The image is split into three sections to fit the page.)

The contents of the status bar include

- A cassette icon that flashes yellow if recording is armed and is steady green when recording is in process.
- A display of the size of the recorded file in time and file size, and the remaining recording time and storage space available on the disk
- The maximum number of video frames queued for compression and waiting to be written to the AVI file at any time during the current recording session—maximum queued units (MQU)
- A count of the number of dropped frames during the current recording session
- A recording indicator; a letter R appears when recording is in process
- Numbers identifying the resolution of the current recording in pixels (horizontal x vertical)
- The instantaneous frame rate in frames per second (fps).

**Note:** During the recording process, the displayed value of the frame rate should match the value you specified in the Global Config pane. If the rate does not match, it is possible that the computer is experiencing partial congestion. Partial congestion is normally caused by non-Plexon applications. Partial congestion does not always result in dropped frames, but some processing might be slightly delayed. In the event that processing ever experiences problems, please contact Plexon support for help in identifying and resolving the issue.
3 Recording Video with CinePlex Studio

3.6 Recording Video without Neural Data (Used for Animal Training)

This section explains how to record video and tracking data without neural data. In this case, the OmniPlex System is activated only for the purpose of providing the required clock for the CinePlex System. This procedure requires activation of the OmniPlex data stream (which starts the clock), and then starting and stopping the CinePlex Studio video recording process locally on the CinePlex System. This method of triggering the recording is typically used during animal training, when no neural data is being collected.

3.6.1 Recording Procedure

Perform these steps to record video data without neural data.

**CAUTION**

Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.

**CAUTION**

Lighting Conditions
If lighting conditions change enough during recording that ‘objects too large’ or some other condition occurs, the position data may be meaningless.

1. Ensure that the system is connected as described in Chapter 2, Installing, Starting and Testing CinePlex Studio.
2. At the OmniPlex System chassis, turn the power on and start the OmniPlex Server and PlexControl.
3. If not already done, configure the OmniPlex System.
4. Click the Start Data button in the PlexControl toolbar so that neural data acquisition begins, and the neural data appears in PlexControl display.
5. Double-click the CinePlex Studio icon. Wait for the CinePlex Studio application main window to appear on the monitor.
   
   **Note:** If Studio does not detect the OmniPlex clock, an error message will appear. If it does, see Appendix F-Troubleshooting.

6. Verify that Cameras is selected in the Studio dropdown list and that a camera image is displayed for each of the camera(s) that will be used in the experiment. The image is displayed for each camera icon that is selected. The image below shows that both Camera 1 and Camera 2 are selected (indicated by the orange color of the icons).
7 If there is an appropriate file containing all the desired CinePlex settings, load the file onto the CinePlex System using the Load settings icon ( ) on the main toolbar or the File/Load Settings menu selection.

8 Click on the Global Config tab in the static configuration pane to display the Global Config pane.

9 View the settings in the Global Config pane and modify any that need to be changed prior to starting the next recording session.

10 To browse for the desired file location (where the recorded files will be saved), click on the browse icon, which is the rectangle with three dots on the Rec Folder row of the Global Config pane.

**Note:** This pane is the first an experimenter will normally use when setting up CinePlex Studio, but perhaps not very often after that. It contains settings that pertain to the frame rate to use when recording, image resolution (quality of recordings to make), compression bit rate and local file recording folder. For information about video formats and the video Quality setting, see Section 3.10.2, “MPEG-4 Quality and File Size” on page 79.
3 Recording Video with CinePlex Studio

11 When the **Browse for Folder** dialog box appears, use standard Windows methods to select or create the appropriate folder. The factory default location for the Recording folder is C:\PlexonData or D:\PlexonData (if disk D is available).

![Browse For Folder dialog box](image)

12 When finished choosing or creating a storage folder, click **OK**.

**Note:** The location of the Recording folder is included in the Settings file (if you save a Settings file), and is restored when the Settings file is loaded. To save settings, click **Save Settings** on the **File** menu, or click the **Save Settings** button ( ![Save Settings button](image)) on the toolbar.

**Note:** If the Recording drive is not NTFS compatible, a warning message displays.

13 To view the CinePlex Studio time display, see the Source pane under the Video window. The image below shows the Source 1 pane, which appears under the Video 1 window for Camera 1. Similar panes appear for each of the cameras you have activated in the previous steps. (Calibration is explained in a later step in this procedure.)
14 In the **Camera** area of the Source pane (labeled with the camera model name), adjust the controls to obtain an acceptable image on the screen. The specific controls vary depending on the camera model. Typical adjustments include **Gain**, **Auto White Balance**, **Brightness**, **Sharpness** and **Saturation**.

**Note:** You can also use other image quality settings. To evaluate image quality settings, manually collect a set of AVI files at different settings and use the file mode to determine a minimum acceptable image quality setting for the experiment. (For information about video formats and the video **Quality** setting, see Section 3.10.2, "MPEG-4 Quality and File Size" on page 79.)
3 Recording Video with CinePlex Studio

**TIP**

**Reducing blurs and color streaks in the video**
If the experimental subject moves quickly, blurs and color streaks can appear in the video. Reduce or eliminate these problems by increasing the shutter speed. See *Shutter Speed* in the Global Configuration settings, as shown in the image above.

15 In the Sources pane, view the digital video recording (DVR) section.

16 In the digital video recording (DVR) area of the Source pane, select the type(s) of output to create - video file (*AVI File*), text file with frame numbers and timestamps (*DVT File*) or both.

17 In the *Timecode* options, select the *In Video* checkbox to include the time. Choose a *Location* and a *Format* setting to configure the display. (CinePlex Studio maintains a time code that tracks the time elapsed since the last time recording began.)

For example, the following images show the time code in the *Upper Left* location in *SSSSS.SSS* and *HH:MM:SS.SSS* format, respectively.
Repeat Step 13 through Step 17 for any other cameras connected to the system.

(Optional) If the arena dimensions have not yet been calibrated, the calibration can be done now. See Section 3.3, “Calibrating the Arena Dimensions” on page 30 for details.

To start recording video, click the Start recording button (the red circular icon) on the CinePlex Studio toolbar. A green cassette icon appears on the status bar to indicate that the recording is in process.

The Pause or resume recording and Stop recording buttons appear on the CinePlex toolbar.

Note: The system automatically checks that there is at least 10 GB of free disk space on the PC before it starts recording a file. The file size can grow to fill the space available, except that the system automatically stops recording the current file when the available disk space has been reduced to 10 GB.

To pause recording, click the Pause or resume recording icon.

CinePlex Studio pauses recording and displays information about the video file in the CinePlex Studio status bar. The status bar flashes green and gray to indicate that the recording is paused.

To resume recording, click the Pause or resume recording icon again.

To stop recording, press the Stop recording icon.

CinePlex Studio stops recording and saves the video file(s) to the location that was specified as Rec Folder in the CinePlex Studio Global Configuration Pane. CinePlex Studio clears the recording information from the status bar and re-arms itself for the next recording session.

The Studio Messages Pane displays information similar to the example below.
3 Recording Video with CinePlex Studio

You can start and stop recording as many times as desired.
To view the captured video file, browse to the file location and double click to open the file.
To transfer files to an analysis computer (if different than the recording computer), follow standard Windows procedures.
To view the video files, navigate to the directory where the files were saved in Step 11) and double click on the desired file to view it.
3.7 Video Playback and Rerecording In Studio Files (Offline) Mode

This section explains how to use CinePlex Studio in offline mode to play back and rerecord video from existing files. The existing AVI and/or DVT files are the ones recorded previously by means of the procedure in Section 3.4, “Recording Synchronized Video Tracking and Neural Data” on page 42.

Offline mode allows existing CinePlex video file(s) to be viewed and embedded data to be extracted. The files can also be rerecorded with different or changed settings from the original recording.

The offline functions of CinePlex Studio can be used on the OmniPlex/CinePlex host PC where the camera(s) are installed, or on a standalone computer. The CinePlex Studio license must be present on the computer.

3.7.1 Entering Offline Mode

CinePlex Studio has two modes of operation: Cameras (online) mode and Files (offline) mode. You can switch from Cameras mode to Files mode using the video source dropdown list on the CinePlex Studio main toolbar, as shown in this drawing.

![Diagram](image)

**Note:** CinePlex Studio comes up in Files (offline) mode automatically if no cameras are detected.

3.7.2 Selecting Files to Be Viewed and/or Rerecorded

Files are represented by icons in the toolbar. You can select from one to four files to process in offline mode, up to the number of cameras licensed for the system. The number in the file icon corresponds to the cameral number on which a file was originally recorded. In the following image, for example, File 1 is selected, therefore the source file must be one that was recorded on Camera 1.

![Files](image)

3.7.3 Managing the Offline Main Window Layout

The image below shows a typical layout with files from Camera 1 and Camera 2 enabled.
The Video Edit pane allows the opened file(s) to be viewed frame by frame.

The Global Config and Source panes allow you to change settings and rerecord the files. (The procedure is presented below.)

Recording is started from the **Start recording from file** button.
3.7.4 Procedure for Loading and Reviewing Video Files

The following procedure organizes the main window and loads the desired files. It also displays the Video Edit pane, which can be used to replay the video file frame by frame.

To view files from a single camera

1. To view files from a single camera, select the appropriate file icon. For example, in the image below, the file from Camera 1 (File 1) is selected.

2. From the Window dropdown menu, select Layout and then Reset to Default Layout.

This action displays the Video Edit pane and the selected Source pane. In the image below, Source 1 is displayed.
3 In the Source pane, in the **File Name** row, click on the folder icon to navigate to the directory containing the desired AVI file and select the file.

**Note:** If you select a file that was created with any camera other than the camera associated with Source, the system will prompt you to select a different file (a file that was created with appropriate camera). The system can automatically detect which camera created the file, regardless of the file name. For example, in the image below, only files created with Camera 1 can be loaded in the Source 1 pane.
The buttons in the Video Edit pane can be used to replay the video file frame by frame.

4 To view files that were created with a different camera, repeat Step 1 through Step 3. (In Step 1, for example, disable all Files except the one file to be worked on next. For example, disable File 1 and enable File 2.)

**To view files from multiple cameras**

1 To view files from multiple cameras, select the appropriate file icons. For example, in the image below, the files from Camera 1 (File 1) and Camera 2 (File 2) are selected.
2 From the **Window** dropdown menu, select **Layout** and then **Reset to Default Layout**.

![Screen capture of CinePlex Studio window with the Window dropdown menu open and the Layout option selected, showing the Reset to Default Layout option.](image-url)
This action displays the Video Edit panes and the selected Source panes. In the image below, Source 1 and Source 2 are displayed.

3 In each of the Source panes, in the **File Name** row, click on the folder icon to navigate to the directory containing the desired AVI file and select the file.

4 The options for file selection and video playback for multiple files are similar to those for a single file. (See To view files from a single camera on page 61.)
3.7.5 Setting the Recording Parameters and Starting the Recording

The recording parameters are set in the Source pane. For example, the image below shows the Source frame for File 2, and the File Name is a file that was originally recorded with Camera 2.

In this pane, you can set parameters that will cause the system to:

- Rerecord CinePlex files previously saved in MJPEG format to the much more compact MPEG format, thus saving storage space
- Rerecord CinePlex files already in MPEG format with a reduced quality setting to reduce further their size and save storage space
- Change quality, brightness, contrast or other settings so that existing files are more usable

If the Tracking Option is installed (now or in the future), the following capabilities are also available:

- Change tracking parameters and retrack the file
- Modify existing tracking parameters and rerecord

In Files mode, CinePlex Studio operating settings can be taken from:

- Existing settings files saved in online mode
- Existing settings files saved in offline mode
- Settings data contained within the AVI files themselves
• New settings made by the user while analyzing the video file(s)
• Modifications made to settings from any of the sources above

Recording of the existing video (with the new settings) is started from the **Start recording from file** button in the main toolbar.

### 3.7.6 Summary of Offline Procedures

This section summarizes the use of the offline procedures.

1. Use CinePlex Studio to record one or more video files on an internal hard drive. If the Recording Folder has not been set, a notification message will display. See Section 3.4.1, “Recording Procedure” on page 42.

2. The AVI and/or DVT files can be rerecorded on the host PC that is part of the CinePlex/OmniPlex System, or the files can be transferred to another computer for analysis computer. When finished copying the files to the analysis computer, rename the files, if desired.

The recommended system requirements for an offline analysis computer include a dual core Intel processor operating at better than 3 GHz with 3 GB of memory, and an NVIDIA® GeForce® 9600 GT or better video card. In addition, the appropriate Plexon license (see Section 1.5, “CinePlex Licensing Options” on page 5) must be plugged in to one of the USB ports. For more detailed discussion of requirements, contact Plexon support at +1-214-369-4957 or support@plexon.com.

3. Extraction (see Section 3.8, “Additional File-processing Tools” on page 69).

### 3.7.7 Offline Functionality Compared to Online Functionality

Most offline functionality is only marginally different from its online equivalent. The major exception is that the optional tracking and behavior functionality in a recorded file will be slightly different than the functionality for live video. This is because the compression techniques used to create AVI files of manageable size inherently discard some of the data that was present in the original, that is, there are losses that occur during compression. In particular, some color, details, and brightness information is compromised. Normally the differences are not visible to the naked eye, but they will cause slight differences in the sensitive algorithms used for tracking analysis (if the Tracking Option is installed).

Differences in the user interface are described below:

• Global Config pane - The frame rate and resolution shown are that of the source files selected. Other sections are unchanged.
• Source pane(s) - Most Camera adjustments are replaced with a file selection browsing tool. In their places are simple adjustments for brightness and contrast. Other sections are unchanged.

3.7.8 Transferring Files to Use in Offline Mode

To enable offline analysis, bring a pair (or multiple pairs) of AVI and neural data files together on the same computer - the “analysis computer”-with CinePlex Editor. You can use a variety of means to transfer the AVI files from the CinePlex Studio internal hard drive to a separate analysis computer, if needed. Likewise, if the neural data files are stored elsewhere, you may transfer the neural data files to the analysis computer, perhaps by using a network connection or some other means. If the analysis computer is the Plexon OmniPlex/CinePlex computer, the neural data files are already stored on local disk(s).
3.7.9 File Naming Procedure in Offline Mode

CinePlex Studio renames files during the rerecording process. After you press the Rec button, CinePlex Studio prompts for new file name(s), and you can accept the name as shown or enter a new name.

If there is only one file being rerecorded, the format of the prompted file name is filename-nn.avi, where:

— filename is the original file name of the opened source file
— nn is a 2-digit number, 01, 02, ... 99 assigned automatically by the system for each new rerecorded file instance

for example:

filename-01.avi, filename-02.avi, filename-03.avi, ...

If there are multiple files being rerecorded, the format of the prompted file name is filenameN-nn.avi, where:

— filenameN is the original file name for one of the opened source files
— nn is a 2-digit number, 01, 02, ... 99 assigned automatically by the system for each new rerecorded file instance

for example:

filename1-01.avi, filename1-02.avi, filename1-03.avi, ...
filename2-01.avi, filename2-02.avi, filename2-03.avi, ...

3.8 Additional File-processing Tools

The following tools can also be used for processing files:

- Use the CinePlex Studio Extractor function to extract static and dynamic data from a Plexon AVI file for analysis with a database program such as Microsoft® SQL Server® or data processing tools such as Microsoft Excel®. See Using the Extractor, below.
- Use CinePlex Editor (or some other method) to match up the AVI file with its partner neural data file, or DVT file, or both, and analyze the data. See Chapter 4, Processing Video Files with CinePlex Editor.
3 Recording Video with CinePlex Studio

3.9 Using the Extractor

This section contains information necessary for setting up and operating the CinePlex Extractor program. CinePlex Extractor is an offline tool that extracts desired static and dynamic data from a Plexon AVI file, placing it into Plexon Settings file format and/or formats suitable for use by database programs such as Microsoft SQL Server or data processing tools such as Microsoft Excel.

Static data in an AVI file includes system information and settings data. Dynamic data includes frame numbers, timestamps and (if the Tracking Option is purchased and installed) positions, speeds, angles, and other computed information.

Before attempting to use the extractor, you must load an AVI file from which the data can be extracted. The selected file must be one that was made during the video recording process (see the recording sections earlier in this chapter).

Extractor operates on one file at a time

The Extractor function can extract either settings or data from a single video file. The procedures in this section explain how to load and process files in the most convenient manner.

Entering offline mode and viewing the main toolbar

1. Verify that Files (offline) mode is selected in the CinePlex Studio main window.

The toolbar displays from one to four file icons depending on the number of cameras licensed.

When the offline main window is displayed, the Extractor icon and Extractor pulldown list selection are both inactive (greyed out), as shown in the image below. The Extractor function remains inactive and cannot be selected until a valid AVI file is loaded.
Selecting a single AVI file

1. To select a file that was originally recorded on Camera 1, select the File 1 icon. The File 1 icon becomes orange, as shown in the image below. Note that the Extractor icon remains inactive.

(To view files from a different camera, select the appropriate File icon.)

2. From the Window dropdown menu, select Layout and then Reset to Default Layout.

This action displays the Video Edit pane and the selected Source pane. In the image below, Source 1 is displayed.
3 In the Source pane, in the File Name row, click on the folder icon to navigate to the directory containing the desired AVI file and select the file.

**Note:** If you select a file that was created with any camera other than the camera associated with Source, the system will prompt you to select a different file (a file that was created with appropriate camera). The system can automatically detect which camera created the file, regardless of the file name. For example, in the image below, only files created with Camera 1 can be loaded in the Source 1 pane.
Note that the Extractor icon and Extractor pulldown option are now active, because a valid file is loaded.
From the File menu select Extractor, or click the Extractor icon ( ) in the toolbar (see the image above to locate these features).

The Extractor dialog box opens.

To extract data, drag and drop entries in the Available Data panel to the panel on the right. When the panel on the right is populated with one or more entries, the Data to Extract banner appears. The order of the entries in the Data to Extract section may be rearranged by dragging and dropping them into the desired position in the list.

When ready to extract the data, click the Extract Data button.

If it is desired to stop the data extraction before the end of the file is reached, click the Stop button.

The data is extracted to a comma-separated-values (CSV) file and can be opened in a spreadsheet application such as Microsoft Excel. The column headings are presented in the order that was specified in the Data to Extract section of the dialog box.
The file can be opened in a text format.

```
1,0.0333333,1
2,0.0666666,2
3,0.0999999,3
```

The CSV file can be opened in an application such as Excel.

The settings from the file may be extracted by clicking the *Extract Settings* button or a DVT file may be created by clicking the *Make DVT 2.0* button. An example of a text file with the extracted settings information is shown below.

```
//CinePlex Studio Settings
CPX_1000 //Common settings
30 //Version number
0 //Number of sources
0 //Camera frame rate
0 //File play speed
0 //Tracking mode
3 //Independent 3D
CPX_1001 //Video compression common settings
75 //Compression
9000000 //MPEG quality
CPX_1003 //Experiment common settings
1 //Sending coords to PLX
2 //Single or multiple animals
3 //View info
CPX_1004 ////Src type
0.5 //Num arenas
0 //Num arena sequences
0 //Num tracking events
CPX_1007 ////Stingray camera
31 //Trig
3 //Frame width
480 //Frame height
1 //Auto gain
0 //Gain
1 //Auto white balance
284 //White balance CR
284 //White balance CB
1 //Auto brightness
16 //Brightness
31.833 //Shutter
```
10 Repeat Step 3 through Step 9 to extract data or settings from any additional files from this same camera.

11 Repeat the entire procedure to extract data or settings from the recordings made by other cameras.

Selecting AVI files from multiple camera sources sequentially

If you want to extract data or settings from multiple cameras, it might be convenient to display the Source panes from all the cameras of interest and then enable one source at a time. For example, if the goal is to extract data for [Experiment A, Cameras 1 and 2], then [Experiment B, Cameras 1 and 2], and so forth, it is convenient to display the Source panes for both Camera 1 and Camera 2, and toggle between the source panes to load files and extract data. The following procedure performs that function.

1 To display Source panes for Camera 1 and Camera 2, select the **File 1** and **File 2** icons. These icons become orange, as shown in the image below. Note that the **Extractor** icon remains inactive.

2 From the **Window** dropdown menu, select **Layout** and then **Reset to Default Layout**.
This action displays the Video Edit pane and the selected Source panes. In the image below, Source 1 and Source 2 are displayed. Note that the Extractor icon remains inactive because a valid file has not yet been loaded.

3 Now that panes for Source 1 and Source 2 are both displayed, it is easy to disable one of the sources at a time. Note that Extractor can only process one AVI file at a time.

For example, to work with Source 1, it is necessary to disable the other sources. In this example, Source 2 needs to be disabled. Click on the File 2 icon to deselect it.

4 Load a file for Source 1 in the same manner as above (as was done in Selecting a single AVI file on page 71).

Note that the Extractor icon is enabled in the toolbar, because a valid file has been loaded.

5 Extract the desired File 1 settings or data (as was done in Selecting a single AVI file on page 71).

6 To work with Source 2, it is necessary to disable the other sources. In this example, Source 1 needs to be disabled and Source 2 enabled.

Select the File 2 icon and deselect the File 1 icon.
3 Recording Video with CinePlex Studio

7 Load a file for Source 2.
8 Extract the desired File 2 settings or data in the same manner as above.
9 Repeat Step 3 through Step 8 as many times as needed to extract settings or data from all the files of interest.
3.10 General Information on Video Formats, Synchronization and Timestamps

This section discusses technical aspects of video recording, including video file formats, synchronization and timestamps.

3.10.1 Reference Information - Digital Video Recorder AVI Files

The Digital Video Recording (DVR) feature of CinePlex Studio stores the video recording from one or more cameras on an internal hard drive. In most experiments, the user simultaneously collects a neural data file in an AVI file. With CinePlex Studio, you may start, stop, and time stamp these AVI files in a way that enables you to subsequently correlate them offline with the simultaneouslyaptured neural data.

Note: If Studio is armed on one day, but the start signal is not received until the next day, the filename remains the one for the previous day.

CinePlex Studio records video into AVI files at a resolution of 640x480 pixels at up to 200 frames per second, which implies a raw data rate of over 700 GB/hour. To reduce disk usage, CinePlex Studio compresses the video using standard MPEG algorithms before it writes it to the AVI file. You can vary the file compression to find a suitable balance between AVI file size and image quality.

3.10.2 MPEG-4 Quality and File Size

MPEG-4 recording format is used because it produces files that are routinely 75 to 90% smaller than the equivalent MJPEG formatted files that were produced by earlier versions of CinePlex Studio.

The CinePlex System Quality settings for MPEG-4 range from 1 to 10. The values represent the nominal bit rate divided by 500,000. The default value of 4 is adequate for most experiments and Plexon recommends using that value unless there is a specific reason to modify it.

Note: If you increase the MPEG Quality setting, for example, increasing it from 4 to 10, the size of the AVI file increases significantly (assuming the same recording duration), but it does not dramatically increase the quality of the image. Conversely, if you reduce the Quality setting, for example, from 4 to 2, the size...
of the AVI file is reduced (for the same recording duration), however, the quality of the image degrades significantly.

3.10.3 MPEG Recording Processes

While it records, CinePlex Studio continually calculates and displays the amount of recording time left until the target hard drive would fill up. As the hard drive capacity is neared, CinePlex Studio stops recording.

The AVI files created by CinePlex Studio are industry-standard AVI-format files that you can play with many standard tools, including Microsoft Windows Media Player, which is pre-installed on most Windows computers. You can also use a variety of commercial software applications to edit and perform other operations on AVI files.

**Note:** Windows Media Player and other video players render files slower than real time if the files were recorded at 40 frames per second or greater. This can be confusing because the slider moves faster than the video plays such that the slider reaches the end of its travel before the video finishes playing.

The MPEG/AVI format allows the embedding of additional data segments within AVI files. Each embedded data segment has an identification tag. Typically, an AVI file reader that does not recognize a tag for an embedded data segment skips that data segment. CinePlex Studio always produces AVI files with a Plexon-specific additional tagged data segment that contains dynamic data, including the frame timestamp, for each video frame. CinePlex Editor can read this additional data segment in the AVI files generated by CinePlex Studio and thus recover the frame timestamp. Other AVI file readers like Windows Media Player ignore this data. This Plexon-specific nondestructive embedded data is not visible on the video frame. However, CinePlex Studio contains an optional feature that can overlay this time stamp in visible numerals on the video image itself; see Section 3.4, “Recording Synchronized Video Tracking and Neural Data” on page 42.

3.10.4 Synchronizing Files from Two Video Cameras

In some cases of synchronizing files from two video cameras, one file can be several frames longer than another due to minor software delays handling the Stop signal. The critical functionality is that the cameras start together and that triggers for corresponding frames occur at exactly the same time.

3.10.5 Synchronizing Video Files with Neural Data Files

To synchronize the video files with the neural data files, both systems must:

- derive all time stamps from the same clock
- start recording both files at the same time - use the same timestamp for relative time zero
- stop recordings at approximately the same time

Use of the same clock to generate the time stamps in each file avoids longer-term “drifting” of the time-base of one file relative to the other. For example, say the
clock controlling the time stamp generation for video frames has a frequency
difference of 1% from the clock controlling the time stamp generation of neural
firing events in the neural data files; after 100 seconds, the occurrences that
should appear as simultaneous in the neural data and AVI files appear instead as
one second apart. Since CinePlex Studio is integrated with an OmniPlex System,
synchronization occurs because CinePlex Studio is controlled with a clock signal
derived from the main OmniPlex System clock. Thus, the PLX and AVI files are
guaranteed to have the same time-base.

**Note:** The CinePlex Studio clock is 1 MHz. This means that the resolution of time
stamps generated by CinePlex Studio is 1 μsec.

When using CinePlex Studio with the OmniPlex System, OmniPlex generates
control signals and routes the signals through the control cable to the appropriate
inputs for CinePlex Studio. To use this mode of operation, *arm* CinePlex Studio
to respond to the electrical control signals. When armed, CinePlex Studio starts
recording the video file exactly one frametime after the start of the neural data
file.

**Note:** CinePlex Studio resets the relative timestamp to zero when armed and
recording is started by PlexControl or when clicking the Record button to
manually start recording a video file. Otherwise the time stamps continue to
increment until CinePlex Studio is shut down.
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4.1 Understanding CinePlex Editor Files

For a complete list of CinePlex® Editor features, see Section 1.7, “CinePlex Editor Features” on page 7.

CAUTION
Upgrade Notice
If the system has been upgraded to CinePlex Version 3, CinePlex Editor should also be updated. The upgraded CinePlex Editor is backwards compatible and will also read AVI files created by CinePlex Capture 1.0, 1.1, 1.2, 1.4, and 2.0.

Although it can be used to work with single files, CinePlex Editor is typically used with a pair of data files recorded in the lab—a video file and a neural data file. To use CinePlex Editor successfully, it is important to understand how CinePlex Editor works with files. This section describes what happens to the various files when creating a CinePlex project, importing data, editing information, saving a project, re-opening a project file, and exporting data.

Note: When using an AVI file and a DVT file, the system uses the timestamps from the DVT file.

Note: When using an AVI file and a PLX file, the system uses the timestamps from the AVI file.

When starting CinePlex Editor for the first time, it prompts for a separate file to store project information. This CinePlex project (CPJ) file can include the following items:

• File references: locations and names of the neural data file and the video file

• Marker definitions, which includes the marker type, name, and any zone or level definitions as appropriate

Note: Markers are a type of indicator or identifier. Marker occurrences are placements of particular markers in a file. For more information on markers, see Section 4.2.4, “Defining a New Marker” on page 92.

• Information for each marker occurrence

4.1.1 Creating a Project File

Normally the first step is to create a CinePlex Project file. To create a project file you must specify the neural data file, which is usually either a PLX or a NEX file (although it can be a DVT file), and the associated AVI video file. The New Project Wizard can step through this process; see Section 4.2.2, “Setting Up a New Project” on page 87. After these files are specified, their file names are stored in the CPJ file, and the initial import of data into the project begins.

Note: A CinePlex Project file can accommodate only one pair of data files—usually a neural data file and a video file.
4.1.2 Importing Data Files

During the initial import of the neural and video data into a project, CinePlex Editor creates markers and marker occurrences based on the contents of the neural data and video files. From the neural data file, CinePlex Editor translates any events (for example, Type 4 data from PLX files) or appropriate NEX variables (event, marker, or interval) into markers and marker occurrences. From the video file, CinePlex Editor creates a Frame marker and creates occurrences for the timestamps of each video frame. However, CinePlex Editor does not store neural data, continuous data, or the video frame images in the CPJ file.

4.1.3 Changing and Saving Project Files

After importing the marker information from the data files into CinePlex Editor and it is in the form of marker occurrences, you may edit, extend, or even delete the information; then you may save the changes to a CPJ file. When saving the CPJ file, CinePlex Editor also saves any new marker information that it creates into the CPJ file. Thus, when re-loading a CPJ file, CinePlex Editor completely restores the markers and marker occurrences that were present when the CPJ file was saved.

4.1.4 Reopening Project Files

When subsequently re-opening a CPJ file, CinePlex Editor gets the marker data exclusively from the CPJ file; CinePlex Editor does not re-import the markers from the neural data or video files. However, CinePlex Editor does find the original neural data and video files on the hard drive, opens them and reads them to get the neural spike data, continuous data, and video images.

Note: Moving the files—If you move the original neural data or video files into the same folder on which the CPJ file resides, CinePlex Editor will find them automatically when it reopens the project file. If you move the original neural data or video files to some other location on the hard drive, CinePlex Editor prompts to locate the files when it reopens the project file.

4.1.5 Exporting Files

Although CPJ files cannot currently be used by any software other than CinePlex Editor, you may export all of the data stored in CPJ files into other formats, such as PLX or NEX data files, text files or comma-separated-values (CSV) files. Text and CSV files can be opened in applications such as Excel® or MATLAB® for additional analysis.
4 Processing Video Files with CinePlex Editor

4.2 Getting Started

This section describes a quick-start example to provide familiarization with CinePlex Editor.

4.2.1 Using the Quick Start Files

This quick-start example uses two sample data files that do not install with CinePlex Editor: CM_Quickstart.plx and CM_Quickstart.AVI. Because these two files are very large, they are located in the Quickstart folder on the USB drive that was delivered with your CinePlex System. As an alternative, instead of using CM_Quickstart.plx and CM_Quickstart.AVI, you may use any video data file (AVI) collected with CinePlex Studio together with a neural data file (PLX, NEX, DVT) collected by MAP or an OmniPlex® System. Before using the quick-start sample files, Plexon recommends copying them to the local disk on the computer to improve performance.

The quick-start example consists of the following series of procedures:

- Section 4.2.2, “Setting Up a New Project” on page 87
- Section 4.2.3, “Understanding the CinePlex Editor Main View” on page 89
- Section 4.2.4, “Defining a New Marker” on page 92
- Section 4.2.5, “Creating Marker Occurrences” on page 93
- Section 4.2.6, “Saving and Exporting the Data” on page 94
- Section 4.2.7, “Re-opening a Project File” on page 96
4.2.2 Setting Up a New Project

This procedure covers the steps required to set up a new project.

1. Click the CinePlex Editor desktop icon or click CinePlex Editor on the Windows® Start menu. The Welcome To CinePlex Editor dialog box opens.

   ![Welcome To CinePlex Editor dialog box]

   **Note:** The Welcome to CinePlex Editor dialog box provides a quick way to start a new project, load an existing project file, or load a recently-used project file. The first time CinePlex Editor runs, CPJ files do not appear in the list box and Open the Selected Recent CinePlex Project is unavailable.

2. Click Start a New CinePlex Project, which starts the New Project Wizard. This wizard is a series of dialog boxes that guide you through the process of setting up a new project. The New Project Wizard opens.

   ![New Project Wizard]

   **Note:**
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3 In the Video Data Input File (AVI) area, click Browse, go to the directory where the quick-start files are stored and locate CM_Quickstart.AVI. Open the file. The New Project Wizard changes all the file names to match.

![New Project Wizard]

**Note:** When you enter a name in the Video Data Input File (AVI) box, the Neural Data Input File (PLX, NEX, DVT) and CinePlex Project File (CPJ) boxes change to reflect the name entered. This is a typical example of the helpful behavior of CinePlex Editor, which suggests file names.

**Note:** For use with CinePlex, AVI files must be saved in Motion JPEG (MJPG) video compression format. If you attempt to open an AVI file that is not in MJPG format, a notification dialog box appears:

![Verify Project Files]

4 For this quick-start procedure, accept the suggested names and click Continue. The Verify Project Files dialog box opens, which contains some basic information to allow verification of the selected files.
If the file information is correct, click **Continue**.

The initial import operations begin; CinePlex Editor creates the CPJ file and opens the CinePlex Editor main view.

### 4.2.3 Understanding the CinePlex Editor Main View

This procedure covers the steps required to set up and control the CinePlex Editor main view.

**Viewing the CinePlex Editor main window**

1. When the CinePlex Editor main view appears, click the maximize button in the Windows title bar to maximize the CinePlex Editor window.

   **Note:** CinePlex Editor is easier to set up and use when its screen area is maximized.

The CinePlex Editor main window should look similar to the following image:

You can reset the window arrangement to the default view by selecting **Window | Layout | Reset to Default Layout**.
The image below shows a typical main screen after some of the procedures in this chapter have been completed.

The first frame of the video file appears in the Video window at the upper-right. Because the CM_QuickStart neural and video data files were recorded using CinePlex Studio with the Tracking option enabled, CinePlex Editor imports the tracking coordinates from the neural data file, and they appear as crosshairs superimposed over the video.

The neural data appears in the Activity window at the bottom, which shows the neural activity at the beginning of the file. Each row in the Activity window represents either a marker or a channel of data. The marker occurrence times and neural firing times for each channel appear as tick marks in the view. You may color code the ticks as appropriate for the marker type and unit designation; for more information, see Section 4.2.4, “Defining a New Marker” on page 92.

The Activity window displays data for markers and channels. If the Show checkbox for a marker or channel is selected, the Activity window displays the marker or channel. If you deselect a checkbox, the associated marker or channel is not displayed in the Activity window.

**Running the video**

2. On the toolbar, click the **Play** button

The video plays, and the neural data scrolls from right to left in the Activity window. This keeps the current video frame at the position marked by the current-time indicator in the Activity window. The current-time indicator is the downward-pointing triangle near the center of the view, which is surrounded by the current frame time and frame number.
3 Click the **Pause** button to pause the display.

**Note:** You may also pause the display by pressing the SPACEBAR key. To restart the display click the **Pause** button or press the spacebar key.

4 Click the **Previous Frame** and **Next Frame** buttons to move backwards or forwards to sequentially view each frame in the display.

**Note:** You may also step through the display by pressing the LEFT ARROW key or the RIGHT ARROW key.

5 Click **Play**. Click the rate buttons (**Slower/Faster**) to decrease or increase the speed of the display. Continued decreasing the speed will eventually cause a reversal to occur, and continued increasing the speed will eventually reach a maximum speed.

**Note:** You may also change the speed by using the UP ARROW key and the DOWN ARROW key on the computer keyboard. You may also select a speed from the drop list on the toolbar.

6 Click the **Reverse Animation** button to switch the direction of play. The speed of the new direction will be the same as in the old direction.

7 Click the **Normal Speed** button to reset the playback speed to normal, which is one times the recorded speed of the video in the forward direction.

8 Click the **Rewind** button to return to the beginning of the file.
4.2.4 Defining a New Marker

This procedure covers the steps required to define a new marker. The Markers window in the upper left corner of the main view shows the set of markers imported from the data files.

The >> indicator denotes the current marker. The Markers window shows the following basic information about each marker:

- **Name** shows the name assigned to the marker. Marker names must be unique.
- **Type** indicates the abbreviation that denotes the type of the marker; for a complete list of marker types, see Section 4.5.1, “Defining Markers” on page 98.
- **Count** shows the number of occurrences or each marker type.
- **Key** indicates the keystroke that is associated with this marker, which can be used to find and insert markers.
- **Show** indicates if the occurrences of this marker display in the Activity window.
- **Display Color** shows the color of the occurrences of this marker in the display views.

For the purpose of this quick-start example, suppose you want to use CinePlex Editor to invalidate intervals in the neural data that were corrupted by artifacts, in this case from the animal chewing. You do this by defining a marker to bracket the chewing interval as in the procedure below.

1. **Click Pause.**

   **Note:** Although pausing is not required, the video can be distracting when performing other operations in CinePlex Editor.

2. **Define a new marker to denote the time intervals that are dominated by artifacts.** This can be done in three ways:
   - Click the **New Marker** button,
   - or, from the **Edit** menu, click **Define New Marker**,
   - or, from the right-click menu in the **Markers** window, select **Define New Marker**.
The Define New Marker dialog box appears.

![Define New Marker dialog box]

**Note:** The F (Frame) marker is a special time-only marker applied automatically by CinePlex Studio to associate a time with each video frame. This marker always appears grayed out in the Define New Marker dialog box because it is system-generated.

3 In the **Type** area, click I to define an interval marker.

4 In the **Name** box, in the place of the default name Interval type “Chewing Artifact.” Retain the default settings for the other items.

**Note:** For explanations for the other items in the Define New Marker window, see Section 4.5.1, “Defining Markers” on page 98.

5 Click **OK**.

The Chewing Artifact entry appears in the Markers window, and the >> symbol appears in the left-most column to indicate that this marker is currently selected. However, there are no occurrences of this marker, so the value in the Count column is 0.

### 4.2.5 Creating Marker Occurrences

This procedure covers the steps required to create new marker occurrences. It is possible to have more than one occurrence for any given marker. You may manually enter marker occurrences in three different ways:

- keystroke
- button click in the Input window
- mouse click in an appropriate view

Each method has advantages and disadvantages; we suggest trying each method to find the appropriate one. For more information on each one of these methods, see Section 4.5.2, “Inserting Marker Occurrences” on page 99.
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This quick-start example covers only the keystroke method. In the previous procedure you defined the Chewing Artifact marker, which appears in the Markers window in the Name column and its associated key appears in the Key column as 5. If you press the 5 key, CinePlex Editor expects an operation with the Chewing Artifact marker.

The available marker operations appear in the Input window, which normally opens directly beneath the Markers window. The Keystroke radio buttons define the operations associated with pressing keys. The default selection is Find. If the 5 key is pressed, CinePlex Editor finds the next occurrence of the Chewing Artifact marker. However, because no occurrences of the Chewing Artifact marker have been created, the 5 key currently has no effect. To create marker occurrences follow the procedure below.

1 In the Markers window, select the Chewing Artifact marker.
2 To arm CinePlex Editor to insert new marker occurrences when pressing the 5 key, in the Input window at Keystroke, click Insert.
3 Click Play, or press the SPACEBAR key.
4 Although interval markers are easier to insert while CinePlex Editor is playing, the default 1X playback speed can be too fast to insert markers precisely. Adjust the playback speed by selecting a slower setting from the speed droplist on the toolbar, for example, 1/8X.
5 To insert an occurrence of the Chewing Artifact marker, press the 5 key once to define the beginning of the interval and press the 5 key again to define the end of the interval.
   Note: You may use other CinePlex Editor capabilities to change marker occurrence intervals, so a convenient work method is to quickly insert placeholder marker occurrences, which can later be edited to set precise start and end times. This is discussed under .
6 Insert several more occurrences using the 5 key. As occurrences are entered, they appear in the ‘Chewing Artifact’ Marker Occurrences window. Each marker occurrence appears with the start and end times for each interval.
   Note: The Marker Occurrences default window is tall and narrow and it can obscure the complete window title. Move the mouse cursor over the title bar to see the complete title. Also, the title of this window changes to include the currently selected marker in single quotation marks. The information that appears in the window also changes for each marker type. For example, a Coordinate marker shows Time, X, and Y coordinates instead of Start Time and End Time.
7 Click Pause. In the Edit Markers window next to Keystroke, click Find.
8 Press the 5 key to advance to an occurrence of the Chewing Artifact marker. Press the 5 key several times to cycle through the intervals entered.

4.2.6 Saving and Exporting the Data

This procedure covers the steps required to save the marked up files from the quick-start example and to export the data for use in other applications. When
saving a project, CinePlex Editor saves all the marker information in the CPJ file. You may also export the marker data to:

- PLX file: The markers become Type 4 Events in the PLX file, along with the spike and continuous data from the original neural data file.
- NEX file: The markers become NEX variables, along with the spike times and continuous data from the original neural data file.
- Text file: Each marker occurrence becomes a line in the text file.
- CSV file: Each marker occurrence becomes a line in the CSV file.

**Note:** Text and CSV files can be opened in applications such as Excel or MATLAB for additional analysis. In an Excel spreadsheet, each marker occurrence becomes a row in the spreadsheet. In a MATLAB file, each marker occurrence becomes a row in a 2D matrix.

To save the project and export the data, follow the procedure below.

1. To save the quick-start example work, click **Save**. The **Save As** dialog box opens with the file name CM_Quickstart-01. Click **Save** to save CM_Quickstart-01.

   **Note:** If you reload the same CPJ file just saved, the system puts CinePlex Editor back into the same state it was in prior to the save operation. CinePlex Editor reloads with the same markers, marker occurrences, current marker selection, etc.

2. For this quick-start example, export the data as a CSV file. From the **File** menu, select **Export Markers**.

   The **Export Marker Data** dialog box opens.

3. In the **Format** area, accept the default value **Text file**. The **Export Marker Data** dialog box includes various options for how, where, and what data to
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export. However, for this quick-start example, accept the defaults values and click Export!

The Export Complete dialog box appears.

4 Locate CM_Quickstart.txt. Open the file with Windows Notepad or another text reader to see how the data is exported.

4.2.7 Re-opening a Project File

This procedure covers the steps required to re-open a project file.

1 Exit and re-start CinePlex Editor.

The Welcome To CinePlex Editor dialog box opens.

![Welcome To CinePlex Editor](image)

Note: The Welcome To CinePlex dialog box now contains an entry for the CM_Quickstart.cpj file in the recent projects list box.

2 Double-click CM_Quickstart.cpj to open the quick-start example project.

CinePlex Editor opens in the same state that it was in when the project file was saved.

3 This completes the last procedure in the Quick-Start Example.
4.3 Using the Activity Window

The Activity window displays data for markers and channels. If the Show checkbox for a marker or channel is selected, the Activity window displays the marker or channel. If you deselect a checkbox, the associated marker or channel is not displayed in the Activity window.

In the Activity window, CinePlex Editor provides two frequently-used items to display neural data—the time pointer and the time range. The time pointer represents the concept of a current instant. The frame in the Video window is the frame whose occurrence time is no later than the current time pointer and is the nearest frame on the left side of the current time pointer. The range of neural data in the Activity window is based on the time pointer.

The inverted white triangle symbol in the Activity window depicts the current time:

![Activity Window](image)

The Activity window displays the current time in seconds \( t \), and the current frame number \( F \). The Activity window default setting positions the current time symbol at the center of the window, so that an equal span of time before and after the current time appears in the window. However, you may reposition the current time symbol by clicking and dragging it with the left mouse button. In this way, you may configure the Activity window to show an asymmetric span of time about the current time; for example, from 1 second before to 5 seconds after the current time.

In general, the time pointer may or may not point to the time of a video frame. The video frame that appears for a given current time is the frame at the latest time, which can be less than or equal to the current time. However, you may configure CinePlex Editor to lock the current time to the times of Frame Markers; see Lock to Video Frames in Section 4.7.5, “Repairing Tracking Coordinates” on page 141.

You may expand or contract the range of time that appears in the Activity window by clicking Zoom In or Zoom Out. You may also shift the current time by dragging the scroll bar at the bottom of the window.

You may also override the current time in a more persistent way by using the Find functions to change the current time to be that of a marker. For example, by clicking the Find Occurrences button, or from the Find menu, select Find Marker Occurrences..., which opens the Find Marker Occurrences dialog box.
4.3.1 Understanding Looping

By default, CinePlex Editor starts in looping mode, where animation and searches that run past the end of the file restart from the beginning. To turn off looping mode, from the Looping menu, click Toggle Looping.

4.4 Customizing the User Interface

Although the default user interface setup in CinePlex Editor may be adequate for the needs, you may also customize the user interface. For details on customizing the user interface, see Appendix E, Navigating the Plexon User Interface.

Some general principles and conventions repeat throughout the CinePlex Editor user interface as well as the Plexon User Interface.

- **Current Selections** – See “Current Selections” on page E-17. The currently selected marker and channel also appear in their selected color (bright violet by default) in the Activity window.
- **Keystroke Shortcuts** – See “Keyboard Customization” on page E-19.
- **Views** – You may quickly close and re-open windows by using the View options or the corresponding toolbar buttons.
- **Undo** – See “Undo” on page E-17.
- **Quick Reference** – See “Help Menu” on page E-12.

4.5 Using Markers and Marker Occurrences

This section explains how to use markers and marker occurrences. Markers are designators that are used to identify or describe timepoints in a file. There can be several types of markers. Each marker type contains specifically-defined information. CinePlex Editor uses seven different marker types; for detailed descriptions of the content of each marker type, see “Marker Type” on page D-72. A marker occurrence is a specific circumstance, or instance, where a marker appears. A marker can have multiple occurrences. Each marker occurrence contains unique information, which consists of a minimum of a timestamp and the other values defined by its marker type.

4.5.1 Defining Markers

To define a CinePlex Marker, designate it as one of the seven available CinePlex types defined in “Marker Type” on page D-72 and name it uniquely. You may add optional information to the definition such as comments, associated keystroke, display color, and associated event IDs. Follow the procedure below to define markers.
1. On the Edit menu, click Define New Marker.
   The Define New Marker dialog box appears.

   ![Define New Marker dialog box](image)

   **Note:** The F (Frame) marker is a special time-only marker applied automatically by CinePlex Studio to associate a time with each video frame. This marker always appears grayed out in the Define New Marker dialog box because it is system-generated.

2. In the Type area, click a marker type.
3. In the Name box, type a unique name for the marker.
4. Add any additional items. For more information, see Section 4.2.4, “Defining a New Marker” on page 92.
5. Click OK.
   The new marker appears as the selected marker in the list in the Markers window. You can select/deselect the Show checkbox to show/hide a particular marker in the Activity window on the CinePlex Editor main screen.

### 4.5.2 Inserting Marker Occurrences

There are three primary methods to insert new marker occurrences:

- Keystroke
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- Button
- Left-Click (of the mouse button)

In the Input window, select an input method. For more information on the Input window, see “Input Window” on page D-17.

Note: You may also use items from the Edit menu to choose one these input methods to insert new marker occurrences. For more information, see “Edit Menu” on page D-38.

Keystroke

To use the keystroke method to insert marker occurrences, associate a key with each marker for which occurrences are created. When defining a marker, you typically associate a keystroke with it. The associated keystroke appears in the Key column of the Markers window.

Note: If there is no associated key with the marker or to change the key association, from the right-click menu in the Markers window, click Edit Selected Marker to open the Edit Marker dialog box. For more information, see “Edit Selected Marker” on page D-40.

To insert marker occurrences using the keystroke method, follow the procedure below.

1. In the Input window, next to Keystroke click Insert.
   
   Note: This arms CinePlex Editor to insert an occurrence of a marker at the current time when pressing the key associated with that marker.

2. Use keystroke insertion when CinePlex Editor is paused or playing. Enter marker occurrences with keystrokes for each marker type as follows:
   
   - For Time Only (T) markers – Press the associated key once to insert a single marker occurrence at the current time.
   
   - For Interval (I) markers – Press the associated key once to start the interval. Press the key a second time to end the interval.
    
   - For Scalar (S) markers – The keystroke behavior for Scalar markers changes with the animation status as follows:
• If paused – Open a Scalar window for the marker. Press the associated key and drag the mouse pointer in the Scalar window to set the value for the new occurrence.
• If playing – Open a Scalar window for the marker. Press the associated key to pause the animation. Drag the mouse pointer in the Scalar window to set the value for the new occurrence.

• For Coordinate (C) markers - Press the associated key and move the mouse pointer in the Video window and click to enter the coordinate values. If it was playing before pressing the key, after clicking, CinePlex Editor enters the new marker occurrence, and resumes animation.

Note: Although you typically insert Level Interval (L) and Zone Interval (Z) markers automatically by using the Levels Editor and Zones Editor dialog boxes, you may also enter them with a keystroke.

Note: For Scalar and Coordinate markers, to use the keystroke or button method you must set the value of the Scalar or Coordinate marker occurrence by clicking the mouse in either the Scalar window or the Video window. For this reason, the left-click input method is better for entering Scalar or Coordinate marker occurrences. Also, it does not make sense to use the keystroke or button input methods unless the Scalar or Video windows are open.

Button Insertion

The Input window includes an associated button for each marker. Each button displays the marker name. CinePlex Editor automatically creates a button for each new marker defined. As you define new markers or reposition the Input window, the button palette rearranges itself. Follow the procedure below:

1. In the Input window, next to Button click Insert.
2. To insert a marker occurrence, in the Input window click the appropriate marker button.
   CinePlex Editor inserts the occurrence at the current time.

Note: With button insertion, each marker type behaves exactly the same as described in the preceding section for keystrokes.

Left-Click Insertion

The Left-Click insertion method is fundamentally different from the other insertion methods. Use the Left-Click method only to insert occurrences for the currently selected marker.

Understanding Click-To-Add Mode

Click-To-Add mode is a semi-automatic subset of the Left-Click insertion method. In Click-To-Add mode, each time a marker is chosen and the left mouse button is clicked, CinePlex Editor inserts an occurrence of the marker and automatically advances the video by a preset number of frames. Two examples follow:

• Example 1: You watch each frame in the Video window and assign a Scalar value to some on-screen behavior, say a number between 1 and 10 for a rat's
activity level. To assign a range to the Scalar window, see “Scalar Right-click Menu” on page D-26. With each frame, left-click in the Scalar window to enter a Scalar marker occurrence with a value that corresponds to the location clicked in the Scalar window, at the time of the current video frame. After each left-click, CinePlex Editor automatically advances to the next frame or to the number of frames set. To set the number of frames, see Number of Frames to Advance During Click-To-Add in “General Tab” on page D-59.

• Example 2: You watch each frame in the Video window and mark some position of interest, for example, the end of the rat’s tail. With each frame, left-click in the Video window to enter a Coordinate marker occurrence with a value that corresponds to the location clicked in the Video window, at the time of the current video frame. After each left-click, CinePlex Editor automatically advances to the next frame or to the number of frames set.

To insert marker occurrences with a mouse click, follow the procedure below.

1. In the Input window, next to Left-Click click Insert.  
   Note: This arms CinePlex Editor to insert an occurrence of a marker at the current time when clicking (left-click) the mouse.

2. In the Markers window, click the marker for which to insert occurrences.  
   A >> appears in the left most column to designate the marker as the currently selected marker.

3. Use mouse click insertion when CinePlex Editor is paused or playing. Enter marker occurrences for each marker type as follows:
   • For Time Only (T) markers – Click in the Activity window only, as follows, otherwise CinePlex Editor ignores the click.
     • If paused – Click anywhere in the window and the occurrence appears at the time corresponding to the pointer location.
     • If playing – Because the display typically moves too fast for precise insertion, click anywhere in the window and the occurrence appears at the current time. Keep the pointer over the Activity window while watching the video and click to insert each occurrence.
   • For Interval (I) markers – Click in the Activity window only, as follows, otherwise CinePlex Editor ignores the click.
     • If paused – Click once to mark the start of the interval. Click a second time to mark the end of the interval. You may enter the ends of the interval in either order, but CinePlex Editor always makes the earlier time the start time for the Interval marker occurrence.
     • If playing – Click once to mark the start of the interval. The start time appears at the current time and the interval expands. Click a second time to mark the end of the interval. The end also appears at the current time. You may keep the pointer over the Activity window while watching the video and click to insert each occurrence.
window while watching the video, then click to mark the start time and click again to mark the end time of each occurrence.

- For Scalar (S) markers – Click in the Scalar window only, as follows, otherwise CinePlex Editor ignores the click.

  - If paused – *Click-To-Add* mode activates; see “Understanding Click-To-Add Mode” on page 101. Click to insert a Scalar marker occurrence with a value (see Note that follows) that corresponds to the location clicked in the Scalar window, at the time of the current video frame. With this feature, you may enter a new Scalar occurrence on every nth frame and then use the **Interpolate Missing Occurrences** feature to fill in the skipped values; see “Understanding Click-To-Add Mode” on page 101.

    **Note:** You must have the Scalar window configured correctly for the desired range of the Scalar value; see “Scalar Right-click Menu” on page D-26.

  - If playing – Click to insert an occurrence at the current time with a value that corresponds to the location clicked in the Scalar window. The animation does not pause.

- For Coordinate (C) markers – Click in the Video window only, as follows, otherwise CinePlex Editor ignores the click.

  - If paused – *Click-To-Add* mode activates; see “Understanding Click-To-Add Mode” on page 101. Click in the Video window to enter a Coordinate marker occurrence with a value that corresponds to the location clicked in the Video window, at the time of the current video frame. With this feature, you may enter a new Coordinate occurrence on every nth frame and then use the interpolate missing occurrences feature to fill in the skipped values; see “Interpolating missing occurrences” on page 113.

  - If playing – Click to insert an occurrence at the current time with a value that corresponds to the location clicked in the Video window. The animation does not pause.

  **Note:** The left-click method works for Level Interval and Zone Interval markers. However, in general you should automatically generate these marker types by using the **Levels Editor** and **Zones Editor** dialog boxes. See Section 4.6, “Using the Freezing Detector, Levels Editor and Zones Editor” on page 119.

### 4.5.3 Editing Markers and Marker Occurrences

This section includes a series of short procedures dealing with markers and marker occurrences. Each procedure uses the most-efficient primary method, but additional methods that can be used to accomplish the same task appear in parentheses after the primary one. Follow the procedure below to delete a selected marker.
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1 In the Markers window, select the marker to delete.

2 From the Markers window right-click menu, choose Delete Selected Marker (or from the Edit menu, choose Delete Selected Marker, or click the Delete Selected Marker button):

CinePlex Editor immediately deletes the selected marker and its marker occurrences.

Note: CinePlex Editor provides no confirmation before it deletes the marker. However, to undo the deletion, from the Edit menu, click Undo.

Deleting all occurrences of a selected marker

1 In the Markers window, select the marker with the marker occurrences to delete.

2 From the Markers window right-click menu, choose Delete all Occurrences of Selected Marker (or from the Edit menu, choose Delete all Occurrences of Selected Marker, or click the Delete all Occurrences of Selected Marker button):

CinePlex Editor immediately deletes all marker occurrences for the selected marker.

Note: CinePlex Editor does not delete the marker itself, but it removes all occurrences of the marker. CinePlex Editor provides no confirmation before it deletes the marker occurrences. However, to undo the deletion, from the Edit menu, click Undo.

Copying a selected marker

1 In the Markers window, select the marker to copy.

2 From the Markers window right-click menu, choose Make Copy of Selected Marker (or from the Edit menu, choose Make Copy of Selected Marker). An exact copy of the selected marker named Copy of <OldMarker> appears in the Markers window.

Note: The new marker has the same marker occurrences. However, the new marker gets new values for the associated key and for the Event ID(s), since those values need to be unique among the markers.
Adding new marker occurrences

1. In the Marker Occurrences window, select the marker for the new occurrence.
2. From the Marker Occurrences window right-click menu, choose Add New Marker Occurrence (or from the Edit menu, choose Add New Marker Occurrence, or click the Add New Marker Occurrence button). The New Marker Occurrence dialog box for the selected marker opens.

Note: For more information on the New Marker Occurrence dialog box, see “Add New Marker Occurrence” on page D-41.

3. In the Time box, type a time in seconds for the marker occurrence. If the marker is a Coordinate marker, type the X and Y coordinates. Click OK.

Editing marker occurrences

1. In the Marker Occurrences window, select the marker occurrence to edit.
2. From the Marker Occurrences window right-click menu, choose Edit Selected Marker Occurrence (or from the Edit menu, choose Edit Selected Marker Occurrence, or click the Edit Marker Occurrence button):

   The Edit Marker Occurrence dialog box opens.

Note: For more information on the Edit Marker Occurrence dialog box, see “Edit Selected Marker Occurrence” on page D-42.

3. In the Time and End Time boxes, type new times in seconds. If the marker type includes coordinates, change these as needed. Click OK.

Deleting selected marker occurrences

1. In the Marker Occurrences window, select a marker occurrence to delete.
   
   Note: To delete more than one occurrence, see Step 3.

2. From the Marker Occurrences window right-click menu, choose Delete Selected Marker Occurrence (or from the Edit menu, choose Delete
Selected Marker Occurrence, or click the Delete Marker Occurrence button):

CinePlex Editor deletes the currently selected marker occurrence.

3 You may also select multiple occurrences to delete. To delete a currently selected marker occurrence plus all of the marker occurrences that are highlighted with a black background in the Marker Occurrences window, from the right-click menu choose Delete Highlighted Marker Occurrences.

CinePlex Editor immediately deletes all of the marker occurrences that are highlighted in the Marker Occurrences window.

Note: CinePlex Editor includes other right-click menu entries for selecting and copying text with marker occurrence information onto the Windows clipboard, which can be pasted into other applications.

4.5.4 Automatically Generating Marker Occurrences

CinePlex Editor can automatically generate marker occurrences. When you define a new marker using the Define New Marker dialog box (see Section 4.2.4, “Defining a New Marker” on page 92), you may choose to have CinePlex Editor populate the new marker with algorithmically-generated marker occurrences. The available algorithms for generating marker occurrences depend on the marker type, which the following sections describe.

Automatically generating Time-Only or Frame Marker occurrences

1 To automatically generate Time-Only or Frame Marker occurrences, in the Define New Marker dialog box, click T then click Generate Occurrences to open the Generate Marker Occurrences dialog box.

2 To generate occurrences for this marker from the occurrences of another marker, click Generate from occurrences of another Marker. Otherwise, go to Step 4.

3 Select a marker from the drop-down list. Click OK.

CinePlex Editor generates marker occurrences at the times of the occurrences of the marker selected in the drop list.
4 To generate occurrences for this marker based on other criteria, click **Generate based on**.

5 To generate regularly-spaced marker occurrences, in the **Time of First Occurrence** box type an offset from the beginning of the file.

6 To space the occurrences at intervals such that they occur at a specified rate, in the **Occurrence Rate** box, type the rate in occurrences per second.

7 To specify the total number of marker occurrences to generate, in the **Number to Generate** box, type the total.

**Note:** Under some conditions, the New Project Wizard also displays the **Generate Marker Occurrences** dialog box so that the required frame marker occurrences can generate. The suggested values that appear in the **Occurrence Rate** and **Number to Generate** edit boxes when the dialog box first appears correspond to the frame rate and number of frames detected in the currently-loaded video data file. In most cases, simply click **OK** to generate appropriate frame marker occurrences.

**Automatically generating Interval marker occurrences**

1 To automatically generate Interval marker occurrences, in the **Define New Marker** dialog box, click **I**, then click **Generate Occurrences** to open the **Generate Interval Marker Occurrences** dialog box.

2 From the **Generate Intervals that cover time spans** drop-down list box, select one of the following algorithms to generate the intervals:

   • **Between Marker 1 and Marker 2** – If this algorithm is selected, go to **Step 3**.

   • **Around Marker 1** – If this algorithm is selected, go to **Step 4**.

   • **Between a time offset from Marker 1 and a time offset from Marker** – If this algorithm is selected, go to **Step 5**.

   • **Defined by time ranges read in from a file** – If this algorithm is selected, go to **Step 6**.
3 Select entries in the **Marker 1** and **Marker 2** lists. Click **OK**.

Intervals generate with a start time that corresponds to the occurrence times of the **Marker 1** selection. The end time correspond to the first subsequent occurrence time of the **Marker 2** selection. CinePlex Editor ignores additional occurrences of Marker 1 that occur before an ending Marker 2.

4 Select entries in the **Marker 1** list. In the two **Time Offset...** boxes, enter time offsets TS and TE in seconds. Click **OK**.

**Note:** For every occurrence of Marker 1 at time t, an interval generates from time t + TS to time t + TE, where TS and TE are the time offsets entered in the first and second marker boxes respectively. TS and TE can be positive or negative.

5 Select entries in the **Marker 1** and **Marker 2** lists, and enter time offsets in the **Time Offset...** boxes. Offsets can be positive or negative. Click **OK**.

**Note:** This is a generalization of the first algorithm where the interval is offset in a fashion similar to the second algorithm from the exact times of the start and end marker occurrences.

6 In the **Ranges File** box, type or select a text file that contains the ranges. Click **OK**.

**Note:** The format of the text file is one range per line of text, with each line containing the start time and end time in seconds. The delimiter between the times can be a comma, a space, or a tab.

**Automatically generating Scalar and Coordinate marker occurrences**

- In the Define New Marker dialog box, if you select **S** (Scalar) or **C** (Coordinate) and click **Generate Occurrences**, CinePlex Editor just generates some fake, random data for testing and demonstration purposes. It has no usefulness in general.

**Automatically generating Level Interval and Zone Interval marker occurrences**

- In the Define New Marker dialog box, if you select **L** (Level Interval) or **R** (Zone Interval) and click **Generate Occurrences**, CinePlex Editor defines the new marker and then opens either the Levels Editor or Zones Editor dialog boxes. Use the editors to generate occurrences based on level crossings for Scalar markers, or Zone containment for Coordinate markers. For basic information, see Section 4.6, “Using the Freezing Detector, Levels Editor and Zones Editor” on page 119. For detailed information on the Levels Editor and Zones Editor, see “Levels Editor” on page D-47 and “Zones Editor” on page D-50.

**4.5.5 Operating with Marker Occurrences**

With CinePlex Editor, you may perform certain simple operations on marker occurrences. You can find, move, and delete occurrences. You may also shift, align and interpolate marker occurrences, and invalidate waveforms that occur either inside or outside of Interval marker occurrences.
Finding Marker Occurrences
CinePlex Editor includes the following three ways to find marker occurrences:

- Keystroke
- Button
- Using the Find menu items or toolbar buttons

Finding marker occurrences with a keystroke
- In the Input window next to Keystroke, click Find. Press the key associated with the marker, which appears in the Key column of the Markers window. CinePlex Editor advances the file in the Activity window to align the first occurrence of the marker with the current time triangle.

Finding marker occurrences with a button click
- In the Input window next to Button, click Find. In the Input window, click the button associated with the marker. CinePlex Editor advances the file in the Activity window to align the first occurrence of the marker with the current time triangle.

For additional information on finding marker occurrences, see “Find Marker Occurrences” on page D-46.

Interval Operations
For Interval, Level Interval, or Zone Interval markers, you may invalidate spike waveforms inside or outside of the Intervals, or remove the occurrences of other markers that fall inside or outside of the intervals.

To use an Interval marker (see Section 4.2.4, “Defining a New Marker” on page 92) for operations, from the Tools menu, click Interval Operations to open the Interval Operations dialog box:

From the Interval Marker to Use list, choose one of the currently-defined Interval, Level Interval, or Zone Interval markers.
To mark as invalid each waveform (spike time) in every channel that falls inside the start and end times of all occurrences of the Interval marker, click **Invalidated Waveforms that occur within the Intervals**. This operation can be inverted; before doing so, see the cautionary note in this section.

If a marker occurrence falls inside a defined interval, you may remove that marker occurrence. To do so, click **Remove Occurrences within the Intervals, for Marker**, and choose a non-Interval marker from the second list. This operation may be inverted; before doing so, see the following cautionary note.

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**CAUTION**

Negate inverts the selection for the entire file

If you click **Negate the selected operation**, the selection is logically inverted. This means you invalidate or remove all the items you did *not* select, which is the entire portion of the file outside the limits of the Interval occurrences.

If you click **Negate the selected operation**, in the **Interval Operations** dialog box, the text in the **Operation to Perform Using Interval Marker** area changes as follows:

If you choose an operation and click **Negate the selected operation**, you either invalidate all waveforms that *do not* fall between the start and end times of any Interval occurrences or remove all occurrences of the selected marker that *do not* occur inside the time span any Interval marker occurrence. For more information on the **Interval Operations** dialog box, see “Interval Operations” on page D-52.

**Shifting Marker Occurrences**

You may add a constant offset, which can be negative, to all the timestamps of a marker. You may use this capability to align neural data files and video files.
Shifting marker occurrences

1 From the Tools menu, click Shift Marker Occurrences to open the Shift Marker Occurrences dialog box:

![Shift Marker Occurrences dialog box](image)

2 Choose a marker from the Marker list.

Note: The first, last, and range of times covered by the occurrences of the chosen marker appear below the Marker list.

3 Choose one of the following methods for specifying the time shift:

- To shift marker occurrences by a fixed amount, in the Shift by box, enter the amount of the shift in seconds.

- To shift marker occurrences so that the first occurrence is at a specified time, enter the specified time in seconds in the Shift so that first Occurrence is at time box. CinePlex Editor applies this shift amount to all occurrences.

- To shift marker occurrences so that the first occurrence of a marker to shift is at the time of another marker occurrence, select the marker representing the time to shift to from the Shift so that first Occurrence is at time of Marker list, and enter the occurrence of the marker to use by typing its 1-based index in the Occurrence box.

4 Click OK to shift the marker occurrences and close the dialog box.

Snap-To Marker Occurrences

The Snap-To Marker Occurrences tool shifts all the occurrences of a marker to match up in time with the occurrences of another marker.

Repositioning marker occurrences to align with others

1 From the Tools menu, choose Snap-To Marker Occurrences

The Snap-To Marker Occurrences dialog box opens.
From the Marker To Adjust list, choose the marker to match up in time. From the Snap-To Occurrences of Marker list, choose the marker representing the occurrences to match in time.

Note: Typically, the entry in Marker To Adjust is the one to align with the times of the video frames and the entry in Snap-To Occurrences of Marker is a Frame marker. CinePlex Editor uses the following algorithm: For every occurrence of the entry in Marker To Adjust, CinePlex Editor finds the best match occurrence of the entry in Snap-To Occurrences of Marker, and makes the occurrence time of the entry in Marker To Adjust equal to the time of the best match occurrence.

To determine the best match occurrence of the entry in Snap-To Occurrences Marker, click one of the following items:

- **Snap-to Previous Occurrence**: Click this item to use the occurrences that are positioned immediately before the times of the entry in Marker To Adjust. This adjustment always reduces the time of the occurrences being adjusted.

- **Snap-to Next Occurrence**: Click this item to use the occurrences that are positioned immediately after the times of the entry in Marker To Adjust. This adjustment always increases the time of the occurrences being adjusted.

- **Snap-to Closest Occurrence**: Click this item to use the occurrences that are closest in time the entry in Marker To Adjust. This adjustment can shift the occurrence being adjusted either direction in time.

If the entry in Marker to Adjust is an Interval-type marker, it consists of two times—a start time and an end time. To adjust the span, which can change the duration of the interval by making both the start and the end times snap to their respective best match occurrences, click Snap interval start and end times independently. To retain the span, which retains the duration of the interval by only making the start times snap to their best match occurrences and shifting the end times to match, click to clear the checkbox.

Click OK to adjust the occurrences and close the dialog box. A confirmation dialog box appears to display how many marker occurrences were moved. The result may be two or more markers with the same timestamp.
Interpolating Missing Marker Occurrences

This tool is useful for adding entries in any gaps in marker occurrences. For example, when tracking some feature on the video by hand, you may enter tracking coordinates only for every $n$th frame, and then interpolate them to complete the remaining frames; this is a form of key-frame animation. Also, CinePlex Studio is occasionally unable to provide valid coordinates for some video frames, for example, when the headset cable for a rat occludes the LED being tracked. You may use this tool to complete tracking coordinates for every frame.

Interpolating missing occurrences

1. From the Tools menu, choose Interpolate Missing Occurrences. The Interpolate Missing Occurrences dialog box opens.

   ![Interpolate Missing Occurrences dialog box]

   

   **Note:** For detailed information on how the interpolation algorithm runs, see "How the Interpolation Algorithm Works" on page D-57.

2. In the Timestamp Determination area, choose one of the following items:
   - Assume Periodicity: If the results in the Perodicity area indicate that the data is truly periodic enough so that filling in gaps by assuming a periodicity is valid, click this item.
   - Use Frame Marker Times: If there should be marker occurrences for the selected marker for every frame, click this item; this lets the frame markers—not the periodicity analysis—determine where missing marker occurrences appear.

3. In the Value Interpolation area, if the marker being interpolated is a Scalar marker or a Coordinates marker, choose one of the following methods to calculate reasonable values to give the added marker occurrences:
   - Sample-and-hold the previous value – Click this item to assign the value or coordinates of the last pre-gap marker occurrence to the new marker occurrences that fill the gap.
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- **Linear Interpolation** – Click this item to assign values to the new marker occurrences that fall on a line connecting the last pre-gap value or coordinates with the first post-gap value or coordinates.

4 To have CinePlex Editor define and populate a new marker to identify the marker occurrences that it generates through interpolation, click **Generate new Time-only Marker at times for added Occurrences**. Otherwise, click to clear the checkbox.

**Note:** If you choose this item, CinePlex Editor defines a new marker name "Interpolated X", where X represents the name of the interpolated marker; this tags the occurrences that are not part of the original data.

5 Click **OK** to close the dialog box.

CinePlex Editor adds the new occurrences to the file and, if you chose the item in Step 4, adds an new row entitled “Interpolated ___” to the list in the Activity window.

### 4.5.6 Selecting and Editing Marker Occurrences

To select a marker, in the Activity window, double-click on any marker time-line, or on the label for a marker. The label of the marker selected appears in the highlight color, which is violet by default.

In the Input window (see “Input Window” on page D-17), if you choose **Select** for the Left-Click input, a left click in the Activity window selects the nearest on-screen marker occurrence for the selected marker. The selected marker occurrence appears with a white box around it:

![Marker Selection Example]

If you select the end time interval, the white box appears around the end time tick mark and the interval line:

![Marker Selection End Example]

In the **Marker Occurrences** window, the newly selected marker occurrence appears with a > next it, and the window can scroll to position the newly selected marker occurrence near the top of the view. If the Activity window is in the mode where it is selecting the nearest marker occurrence, the mouse pointer becomes white crosshairs.

In the Activity window, the status bar shows useful information about the selected marker and marker occurrence. The name of the selected marker appears and the 1-based index of the selected marker occurrence; for example, in the
following image idx indicates the 4th occurrence of this marker and t indicates its time in seconds:

In the Activity window, you may also drag selected marker occurrences to different times; this enables you to make minor adjustments to the positioning of marker occurrences. To drag a marker occurrence to a new time, hold down the \texttt{SHIFT} key, click the marker occurrence, and drag it to a new time. For Interval-type markers, you may independently adjust the start and end times; for selection techniques, see the preceding paragraphs.

\subsection*{4.5.7 Entering or Editing Coordinate Markers}

In the Input window (see “Input Window” on page D-17), if you choose \texttt{Insert} for the \texttt{Left-Click} input and the selected marker is a Coordinate marker, you may enter or change coordinates by clicking in the Video window. If the Video window is in the mode where a left-click can change or add new Coordinate marker occurrences, the mouse pointer in the Video window changes to crosshairs and a line of text at the bottom of the window shows the current coordinates.

Because CinePlex Editor can enable only one marker occurrence for any given time, if you enter a new coordinate at the time of an existing marker occurrence, you effectively replace the existing coordinates. Thus, if the Coordinate marker occurrences occur at the same time as the Frame marker occurrences, you may \textit{touch up} existing coordinates with a simple click on the new location.

By default, the Click-To-Add feature (see “Left-Click Insertion” on page 101) automatically advances a number of frames, so if you continually click in the Video window you can quickly enter a sequence of coordinates on subsequent video frames.

\subsection*{4.5.8 Importing Markers}

CinePlex Editor can import additional markers and marker occurrences from additional neural data files into an existing project. You may add neural data files to the project and process them as during the initial import of neural data when the project was first created (see Section 4.2.2, “Setting Up a New Project” on page 87). You may turn their events (from PLX files) or variables (from NEX files) into the appropriate markers and marker occurrences.

To import markers, from the \texttt{File} menu, click \texttt{Import Markers} to open a Windows file selection dialog box for the neural data file. After selecting the file, click \texttt{OK} to import the data from that file as new markers. CinePlex Editor must have unique marker names, so if a marker name from the imported neural data files conflicts with an existing marker, CinePlex Editor renames the file by adding “\texttt{\_n}” to the name, and increasing the number \texttt{n} until it establishes a unique name.
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4.5.9 Exporting Markers to text or CSV files

CinePlex Editor can export marker occurrences data in a tabular format to either a text file or comma-separated-values (CSV) file. Files in either of those formats can then be imported into other applications for data analysis. For example, a CSV file can be opened in MATLAB or Excel programs.

Exporting makers as Text or CSV files

1. From the File menu, click Export Markers to open the Export Marker Data dialog box.
   The Export Marker Data dialog box opens.

2. In the Format area, select the type of file to export.
3. For all formats, CinePlex Editor exports one marker occurrence per row (or per line for text files), and all rows have the same number of columns.
   For Text file only: From the Delimiter to use between values list, select one of the following delimiters: Comma; Comma, Space; Space; Semicolon; or Tab.
4. If you want the file to have a header row, click Export a Row of Column Headers.
5 In the **Which Markers** area, click **Selected Marker only** to export only the occurrences for the selected marker. To export the occurrences for all markers, click **All Markers**.

6 You may set the columns for each row in the **What to Export for Each Marker Occurrence** area. For more information on exporting marker data, see “Export Markers” on page D-32.

7 In the **Output File** area, in the **File** box, type or select the output file name.

8 In the **Output File** area, click the **Append if existing** checkbox to append the marker data onto the end of a file that already exists on disk. Otherwise, CinePlex Editor overwrites the existing file.

![](warning_icon) **CAUTION**

**Set the Append if existing checkbox correctly**

Pay special attention to the **Append if existing** checkbox. If it is **checked**, the new marker data will be appended to the existing file. If it is **unchecked**, the new export file will overwrite the current export file.

9 Click **Export!** to create the file and close the dialog box. The **Export Complete** dialog box appears.

### 4.5.10 Exporting as a PLX File

CinePlex Editor can export marker occurrences data along with spike and continuous data read in from the original neural data file to a new PLX file.

**Mapping Markers to Event IDs**

When exporting to a PLX file, the marker occurrences in the project are represented as external events (type 4 data) in the output PLX file. There are two kinds of external events in the PLX file format:

1. **Individual External Events** – These events appear only by their Event ID, and each occurrence includes a timestamp only. There can be many different Individual External Events (with different Event IDs) present in a PLX file.

2. **Strobed Events** – These events appear only by a special Event ID, so only one strobed event can be in a PLX file. Each occurrence of a strobed event stores a timestamp plus a single 16-bit value, called the strobe code.

You must define a mapping between markers and Event IDs before CinePlex Editor can represent marker occurrences as external events.

Each marker for which the marker occurrences are to be exported to a PLX file must have its own unique Event ID. You may define or edit the Event IDs in the **Define New Marker** or **New Marker Occurrence** dialog boxes (see “Define New Marker” on page D-39 and “Add New Marker Occurrence” on page D-41), or you may change them in the **Export To PLX** dialog box (see “Export to PLX” on page D-36).
The fact that individual external events do not have any data values associated with them means that only Time-Only, Frame, and Interval-type (Interval, Level Interval, or Zone Interval) markers can be represented by using individual external events. For Interval-type markers, specify two Event IDs, one to represent the start time of the interval and one to represent the end time.

Furthermore, the fact that a PLX file can only contain one kind of strobed events means that only a limited number of Scalar or Coordinates markers can simultaneously appear in a single PLX file. For example, if the strobed events in a PLX file are to represent all the occurrences of a certain Scalar marker, then there is no way to represent another scalar marker or any coordinates markers in the same PLX file.

Because of the existence of the VideoTracker protocol, coordinates markers can be represented in a PLX file. Up to three coordinates markers can be represented using the VideoTracker protocol in a single PLX file, along with an additional scalar marker.

4.5.11 Exporting as a NEX File

CinePlex Editor can export marker occurrences data along with spike and continuous data read in from the original neural data file to a new NEX file. For information on mapping from markers to NEX variables, see “Export to NEX” on page D-37.
4.6 Using the Freezing Detector, Levels Editor and Zones Editor

This section explains how to use the tools that CinePlex Editor provides for

- Detecting animal freezing behavior—See Section 4.6.1, “Using the Freezing Detector” on page 119
- Identifying times during which a measured scalar parameter meets a specific user-defined level—See Section 4.6.2, “Using the Levels Editor” on page 130.
- Identifying times during which a specified coordinate marker entered and left a defined zone—See Section 4.6.3, “Using the Zones Editor” on page 134

4.6.1 Using the Freezing Detector

You can use the Freezing Detector in CinePlex Editor to detect animal “freezing” behavior and insert marker occurrences for each set of freezing episodes.

Understanding how the Freezing Detector works

An active, normally behaving animal might stop moving for a period of time (freeze) due to anxiety or fear or a specific stimulus. With the Freezing Detector function, you can define parameters that enable the system to detect and display periods of animal freezing behavior. You can average the Motion Measure, set the freezing threshold, span gaps between closely spaced events, then generate markers around the freezing episodes that result. Multiple sets of detected freezing episodes can be created with varying parameters, reviewed, modified if needed, and saved for future use in the CPJ project file.

Note: The Motion Measure is the normalized contour difference of the animal’s body computed on a frame-by-frame basis. The Freezing Detector averages (smoothes) the Motion Measure data within a user-specified time window (Averaging Wnd parameter) and compares the averaged motion data to a user-specified threshold value and minimum freeze duration value.

Note: Motion Measure data can be created during a CinePlex Studio recording (or re-recording) session only with the Object Contour tracking method. See Section 5.7, “Object Contour Tracking” on page 161 for information about this tracking method.

See also “Examples of Freezing Detector settings and results” on page 127 following the procedure.
Opening and using the Freezing Detector dialog box

1. To open the **Freezing Detector** dialog box, from the **Tools** menu, click **Freezing Detector**.

   ![Screenshot of Freezing Detector dialog box]

   The **Freezing Detector** dialog box opens.
In the **Scalar Marker To Use** menu, select the type of file you want the system to use to obtain the Motion Measure data. (See the image below.)

If the project file (CPJ file) that you created (see [Section 4.1.1, "Creating a Project File" on page 84](#)) includes an AVI and PLX pair, and if Motion Measure was recorded in the AVI file and sent to the PLX file, you can use the Motion Measure data from either of these files. (The Motion Measure data will be identical in these AVI and PLX files.) In this case, the **Freezing Detector** dialog box droplist displays these options as shown in the image below. Select **AVI Motion** or **PLX Motion**.

![Image of Freezing Detector dialog box with AVI Motion and PLX Motion options selected](image1.png)

If the project file also includes a DVT file with Motion Measure data recorded, you can use the Motion Measure data from this DVT file. In this case, the **Freezing Detector** dialog box droplist displays all of these options as shown in the image below. Select **AVI Motion**, **PLX Motion** or **DVT Motion**.

![Image of Freezing Detector dialog box with AVI Motion, PLX Motion and DVT Motion options](image2.png)

**Note:** For the Freezing Detector function to be used, the AVI, DVT or PLX file you select must contain Motion Measure data, as explained earlier in this section.
Click the Add button. The Define New Marker dialog box opens.

Note: The Type area of the dialog box (above) is grayed out because the system recognizes that you are creating a freezing episodes marker.

Every marker you create will automatically be displayed in the Markers and Input from Marker Selected windows. If you select the Show checkbox, the marker will be displayed in the Activity window also.

Use the options in this dialog box to set parameters that affect how the system detects and displays data in the Freezing Detector dialog box:

- **Name**—Enter a name for this set of freezing markers, for example, Freezing Episodes #1.
- **Comment**—Optional text field.
- **Associated Keystroke**—A single letter that you will use if you want to manually create a freezing marker.
- **Display**—The color to associate with the freezing marker (for easier identification in the display), and a Show checkbox to specify whether the marker will be displayed in the Activity window.
- **Event IDs**—The start and end identifiers for each freezing episode.

Click OK.
The new Freezing Episode appears in the **Freezing Detector** dialog box. A typical display is shown in the image below.

The **Freezing Detector** dialog box displays the following data:

- **Black triangle** in the left margin of the dialog box (see the red highlighting in the diagram, above)—Click on a row in the table to select it; the triangle in the left margin shows that the row is selected, and the graph displays the data for the selected row.

- **Color**—The user-specified color associated with the marker. You can change a color by clicking on it and selecting a new color from the droplist.

- **Threshold** value (in the table) and horizontal line (in the graphical display)—In the above image, the horizontal red line is set to the user-defined threshold for Freezing Episodes #1. You can raise or lower this threshold by clicking and dragging the horizontal line with the PC mouse or by double clicking the Threshold value in the table and typing a new value.

**Note:** The image below shows an example of changing a parameter value by double clicking it and entering a new value. In this example, the user has entered a new value for the **Averaging Wnd** in the second row of the table:
• **Averaging Wnd (Window)**—The time period, in seconds, over which the system averages the animal's movement. You can change this value by double clicking the number in the table and typing a new value. The averaging calculation smooths the motion data during the specified time period. A larger window provides more smoothing effect than a smaller window. The Averaging Wnd size can be adjusted between 0.1 and 10.0 seconds (default 0.5 seconds).

• **Min Freeze Time**—The minimum time duration that the animal's movement must be less than the user-defined Threshold to be considered a freezing episode; if this time duration is exceeded, a freezing episode has occurred and the system generates a freezing marker instance. You can change this value by double clicking the number in the table and typing a new value. The Min Freeze Time can be adjusted between 0.1 and 10.0 seconds (default 2.0 seconds).

• **Show Original Data**—If this checkbox is selected, the window displays the original motion measure data (the amount of positional change by the center of gravity of the animal from one video frame to the next) along with the averaged (smoothed) freezing measure data.

• **Max Value** and **Min Value** and graphical display—This area plots the freezing measure data and the original Motion Measure data (if the Show Original Data checkbox is selected). It also displays the maximum and minimum numerical values of the graphical data.

• **Merge Episodes**—If you select this checkbox, the system merges two freezing episodes into a single episode even if there is a short active gap between the freezing episodes (see **Gap Sizes to Merge**, below). You can select/deselect this checkbox by clicking on it.

• **Gap Sizes to Merge** (used only if the Merge Episodes checkbox is selected)—Specifies the active gap size, which is the time, in seconds, during which the animal’s averaged motion data can exceed the Threshold value between freezing episodes and still identify the two freezing episodes as a single merged episode. You can change this value by double clicking the number in the table and typing a new value. The gap size can be adjusted between 0.1 and 10.0 seconds (default 0.2 seconds).
• **Add** button—Opens the **Define New Marker** dialog box, which allows you to add another Freezing Episodes marker.

• **Delete** button—Deletes the selected row in the table.

• **Center Level** button—Changes the Threshold value to the average of the Max Value and Min Value of the plotted data. In the first image below, the **Show Original Data** checkbox is selected, and the **Center Level** line shows the mean of the Min Value and Max Value for the original data. In the second image, the checkbox is deselected and only the averaged data for the selected row is plotted; in this case, the **Center Level** line shows the mean of the Min Value and Max Value for the averaged (smoothed) data.
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Generating new Freezing Episodes results in the Activity window

6 Click the Generate for All Levels or Generate for Selected Level button to generate new freezing marker occurrences in the Activity window.

The Generate for All Levels button generates new results for all freezing episodes rows in the table. The Generate for Selected Level button generates new results only for the selected freezing episodes row in the table (that is, the row with the triangle appearing in the left margin of the row).
Examples of Freezing Detector settings and results

The two images below show the same data. In the first image, the **Show Original Data** checkbox is selected; in the second image, it is not selected:
The images below show two sets of freezing calculations for the same data. For Episodes #1, **Averaging Wnd** is set to 0.50 second; for Episodes #2 it is set to 8.00 seconds. Note that the averaged (smoothed) data is different for these two cases, even though the original motion data is the same.
The first image below shows two sets of freezing episodes for the same data. For Episodes #1, the **Min Freezing Time** is set to 2 seconds; for Episodes #2 it is set to 6 seconds. The second image shows a portion of the Activity window after the **Generate for All Levels** button is pushed. Note that freezing episodes with a shorter freeze time (< 6 seconds) are marked only for the Episodes #1 function (red line), not the Episodes #2 function (green line):
4.6.2 Using the Levels Editor

You can use the Levels Editor to define Level Interval markers and insert marker occurrences for them. Level Interval marker occurrences indicate the time intervals during which the values of a Scalar marker satisfied some condition. You may use the Levels Editor to set up the conditions, apply the conditions to a specific Scalar marker, and generate occurrences of the selected Level Interval marker or markers.

Level Interval markers are like Interval markers, but they are extended to store additional information that defines a condition. This additional information appears with the Level Interval marker definition in the CPJ file. The occurrence of a Level Interval marker is always tied to the values of the occurrence of a Scalar marker.

For the examples in this section, the Motion Scalar marker is used, but you can use the Level Interval marker with any Scalar marker.

To use the Levels Editor

1. On the Tools menu, click Levels Editor or click the Edit Levels button on the toolbar.

   The Levels Editor dialog box opens.

2. To define a new Level Interval marker, click Add.

   The Define New Marker dialog box (see “Define New Marker” on page D-39) opens to enable you to customize the general properties of the new Level Interval marker.
3 Define the new marker and click **OK** to close the Define New Marker dialog box.

A new row appears in the **Level Intervals** box.

![Level Intervals](image)

4 Double click on the parameters in the table to specify the levels you want for this marker. (The parameters become editable when you double click on them.)

For each Level Interval, you can specify either a one-level or two-level setting. When one level is used, **N/A** appears in the **Oper** field. When two levels are used, a logical operator is placed between the two levels (**AND** or **OR** is selected in the **Oper** field).
In this example, a marker will be generated when the actual value of the animal's motion is above 151.

In this example, a marker will be generated when the actual value of the animal's motion is between 151 and 297.
5 You can define additional Level Interval markers by following the same procedure as in Step 2 through Step 4. In the following example, two different Level Interval markers are specified. The graph displays the levels for the row that is selected in the table.

Generating new Level Intervals results in the Activity window

6 Click the Generate for All Levels or Generate for Selected Level button to generate new Level Interval marker occurrences in the Activity window.

The Generate for All Levels button generates new results for all Level Interval rows in the table. The Generate for Selected Level button generates new results only for the selected Level Interval row in the table (that is, the row with the triangle appearing in the left margin of the row).
4.6.3 Using the Zones Editor

You may use the Zones Editor to define Zone Interval markers and generate marker occurrences for them. To open the Zones Editor dialog box, on the Tools menu, click Zones Editor (or click the Edit Zones button on the toolbar):

Zone Interval Markers

Zone Interval marker occurrences indicate the time intervals during which a Coordinate marker occurrence remains inside a Zone that is defined. You may use the Zones Editor dialog box to define the Zones, to search for the times when the specified Coordinate marker entered and left the defined Zones, and generate Zone Interval marker occurrences.

Zone Interval markers are Interval markers, but they are extended to store additional information that defines a Zone. This additional information appears with the Zone Interval marker definition in the CPJ file. A Zone is an ordered list of coordinates that are connected with line segments, to form a closed Zone. Zone Interval marker occurrences are always tied to the values of the occurrence of a Coordinates marker.

The coordinate system for all Coordinate markers, and therefore also for all Zone definitions, range from (0,0) to (1023,767), with (0,0) representing the lower left
corner of the image. If the video resolution is other than 1024x768, which is usually the case, the coordinates are linearly mapped onto the video.

To use the Zones Editor

1. On the Tools menu, click Zones Editor.
   The Zones Editor dialog box opens.

2. To define a new Zone Interval marker, under the Zone Intervals area click Add.
   The Define New Marker dialog box (see "Define New Marker" on page D-39) opens to enable you to customize the general properties of the new Zone Interval marker.

3. Define the new marker and click OK to close the Define New Marker dialog box.
   A new row appears in the Zone Intervals box.

   Note: Immediately after you create a new Zone Interval marker, Zones Editor enables you to click in the video window to set the X and Y Coordinates of the Selected Zone. The box directly above the video then contains this text:
   
   **Left-Click on the view to add a new coordinate; Right-Click to end**

4. Move the mouse pointer into the Zones Editor video area.
   The mouse pointer changes to crosshairs and the current pointer location coordinates appear under X and Y in the Coordinates of the Selected Zone area.
5 Move the pointer to the desired location for the first coordinates of the selected Zone. Click to add the first coordinates.

The first set of coordinates appear as line 1 in the Coordinates of the Selected Zone box and line 2 indicates the current pointer position.

**Note:** As you move the mouse pointer, a line follows it from the first coordinates to its current location. The current location always appears as a small circle with a white interior.

6 Move the pointer to the desired location and click again to add the second set of coordinates, and so on. Stop entering coordinates when the next set would be the starting point.

7 Click the right mouse button.

The Zones Editor automatically closes the Zone by making the last coordinate the same as the first coordinate.

You may select a point at a vertex of a selected Zone Interval by clicking on a line in the Coordinates of the Selected Zone box. The point you select appears with a >> in the leftmost column box and as a small circle with a white interior in the video area.

After you have defined the Zones, you may generate Marker occurrences just for the selected Zone Interval marker, or for all Zone Interval markers by clicking Generate Selected or Generate All.
4.7 CinePlex Editor How-Tos

This section contains suggested procedures for several common operations in CinePlex Editor. These procedures are by no means meant to be an exhaustive list of what can be done with CinePlex Editor, nor are they intended to be a presentation of the only possible way to achieve any desired end result.

**Note:** The following procedures assume a project has already been created and that it is currently open. For details on how to create CinePlex projects, see Section 4.2.2, “Setting Up a New Project” on page 87.

4.7.1 Printing

Several windows in CinePlex Editor support rudimentary printing. To print a specific window, click in the window so the title bar is highlighted. If the window supports printing, the **Print** and **Print Preview** items on the **File** menu are available. The **Input** and **Scalar** windows do not support printing.

4.7.2 Denoting Interesting Behavior In the Video

A basic use for CinePlex Editor is to introduce a new marker occurrence into the data each time an animal or other subject in the video performs an action that is of interest in an experiment. For example, perhaps a neuron is suspected to be associated with a rat deciding to get a drink of water. You might test this hypothesis by introducing a time marker into the data whenever the rat drinks his first sip of water, as shown by the video. Then it would be desirable to perform a peri-event analysis against this new event in NeuroExplorer® to see if any neurons are associated with the first sip.

The procedural approach here is to define a new Time-only marker in CinePlex Editor, then enter marker occurrences whenever the rat starts to sip water. Initially, we *rough in* all the marker occurrences during one continuous pass through the video, then we go back and adjust each marker occurrence to be as accurate as possible. Then this information is saved to a NEX file, from which we can easily load it into NeuroExplorer for analysis.

**Denoting interesting behavior in the video**

1. Define a new Time-only marker as described in Section 4.2.4, "Defining a New Marker" on page 92. Label it “First Sip.” Assign a keystroke to it that is easy to press quickly.

2. Click **Play**. Adjust the **Faster** and **Slower** settings to a comfortable speed to view the video, which balances the desire to get through the video quickly against the risk of missing the behavior should it occur too quickly to spot.

3. Use the **Zoom In** and **Zoom Out** buttons at the bottom of the Activity window to adjust the time range such that, should the sip behavior be spotted in the video view, a key on the keyboard can be hit before the time of the first sip scrolls out of the **Activity** window.

4. In the Input window, at **Keystroke**, click **Insert** (You could just as easily use the **Left-click** or **Button** input methods here.). CinePlex Editor is now armed
4 Processing Video Files with CinePlex Editor

to enter new occurrences of the new marker when pressing that marker’s associated key.

5 Click **Rewind**. Click **Play**. Position a finger over the associated keystroke for the “First Sip” event.

6 When the sip behavior is observed, quickly press the key associated with the “First Sip” marker. Accuracy is not important at this point; fine-tuning will come later. Go through the entire video.

7 Now, let’s go back through and adjust the time of the “First Sip” marker occurrences to be more accurate. We will use the **Find** function to quickly locate our marker occurrences. In the Input window, after **Keystroke**, click **Find**.

8 Rewind the video file, then press the assigned key for the “First Sip” marker. This causes the system to jump to the first marker occurrence. Use the left and right arrow keys on the keyboard to look at each frame of the video to decide where the sip actually occurs.

9 In the Activity window, drag the marker occurrences to the correct time. To do so, press and hold the **SHIFT** key, then click near the tick mark for the marker occurrence. Drag the tick mark to the desired time and release the mouse button.

10 To save the data, on the **File** menu, click **Export to NEX**, and if desired, select the appropriate **What to Export** checkboxes. Click **Export!** to write the file.

4.7.3 Invalidating Artifact Waveforms

Artifact waveforms can occur, for example, because a rat rapidly shakes its head. This behavior can easily be spotted in the video view, and it generally produces a cluster of spikes and large voltage deviations in a continuous data channel. It is desirable to invalidate all spike waveforms that occur during each head-shaking episode, and save the data to a new PLX file that does not contain those invalidated waveforms. This file can then be loaded into Offline Sorter™ and sorted.

The procedural approach here is to define a new Interval marker, whose occurrences start and end when the head-shaking episodes start and end. We then use this Interval marker to invalidate the spike waveforms that occur within the head-shaking episodes. We then save the data to a new PLX file minus the invalidated spike waveforms.

**Invalidating artifact waveforms**

1 Define a new Interval marker (see Section 4.2.4, “Defining a New Marker” on page 92). Label it “Head Shake”. Make sure that the new marker is the currently-selected marker.

2 In the **Channels** window (see “Channels Window” on page D-17), click **Show** for the spike and continuous channels that are the best indicators of when this artifact occurs, which makes them appear in the Activity window.

3 Use the **Zoom Out** button at the bottom of the Activity window to expand the time range as much as possible, which helps to examine the file quickly.
However, do not expand the range so far that the artifact cannot be spotted should it occur.

4 In the Input window, at **Left-Click**, click **Insert** (Or use the **Left-click** or **Button** input methods here). CinePlex Editor is now armed to enter new occurrences of the new marker when pressing that marker's associated key.

5 Starting at the beginning of the file, click **Play**. If it doesn't make the behavior too difficult to spot as it scrolls by, increase the speed of the playback so that the file can be reviewed quickly.

6 When the head shake behavior is observed, quickly press **SPACEBAR** to pause the playback. Use the left and right arrows to single-step the frames to verify the head shake and decide when the head shake behavior begins and ends.

7 In the Activity window, left-click at the starting and ending times of the head shake episode. This inserts new marker occurrences of the “Head Shake” marker.

8 Press **SPACEBAR** to resume playing. Repeat Steps 6, 7, and 8 for each head shaking episode until the end of the file is reached.

9 From the **Tools** menu, click **Interval Operations**. Select the “Head Shake” marker from the **Interval Marker to Use** list. Click **Invalidate Waveforms that occur within the Intervals**. Click **OK**.

10 Now all of the spikes that occur within the head shake episodes have been invalidated. To hide invalidated spikes in the Activity window, open the right-click menu and click **Hide Invalidated Spikes**.

11 To save the data, from the **File** menu, click **Export to PLX**. Verify that the **Export invalidated spikes** checkbox is clear (the default). If desired, check
4.7.4 Entering Tracker Coordinates

Suppose that it is desirable to track the movement of some subtle feature on the video image. Something that CinePlex Studio cannot track automatically, like the position of the tip of a rat's tail.

The procedural approach here is to define a new Coordinates marker, and use the Video window to enter—by mouse click—the coordinates that populate the new marker. Then, you can use the Interpolate Missing Occurrences tool to fill in the in-between frames.

**Entering tracking coordinates**

1. Define a new Coordinates marker (see Section 4.2.4, “Defining a New Marker” on page 92). Label it “Tail Position”.

2. In the Input window, after Left-Click, click Insert. CinePlex Editor is now “armed” to create a new occurrence of the “Tail Position” marker whenever clicking in the Video window.

3. Decide how often coordinates need to be entered. The default case is to enter a Coordinates maker occurrence for each and every video frame. However, this means that the video must be advanced frame-by-frame, which can take a long time to do the tracking for an entire experimental run. If less accuracy is acceptable, it is possible to configure CinePlex Editor automatically to advance $N$ video frames each time a coordinate is entered by clicking. This means that a “Tail Position” coordinate is entered only every $N$th frame, but transversing the file occurs $N$ times faster. From the Tools menu, select Options, and click the General tab in the Options dialog box. Type the value of $N$ into the Number of Frames to Advance During Click-To-Add edit box. The default is $N = 1$, which enters a coordinate for every video frame.

4. Click Play, then Pause, then Rewind to return to the beginning of the file. This ensures that CinePlex Editor is ready to take new coordinates.

5. In the Video window, click at the position of the tip of the rat's tail. CinePlex Editor enters a new marker occurrence, and advances $N$ video frames.

6. Repeat Step 5 until all the data needed has been gathered.

7. When finished, in the Input window, at Left-Click, click Select to “disarm” CinePlex Editor.

8. It is possible to generate automatically new “Tail Position” marker occurrences for the skipped frames by interpolating the coordinates between the ones entered. This is similar to “key-frame” animation techniques. CinePlex Editor interpolates the coordinates mathematically with no regard for the video images—the interpolated positions may or may not match the actual positions of the rat's tail on the skipped video frames. To perform this operation, from the Tools menu, select Interpolate Missing Occurrences; for more information, see “Interpolating missing occurrences” on page 113. From the Marker list, select Tail Position. Because we want coordinates for every frame, in the Timestamp Determination area, click Use Frame.
Marker Times. Click OK to close the dialog box and enter the tracking coordinates.

4.7.5 Repairing Tracking Coordinates

Suppose that CinePlex Studio is used to track an LED mounted to the headstage on a rat. Occasionally, the cable from the headstage can get between the LED and the camera, so the position data for the LED is missing in some frames. Or, suppose something caused the tracker to produce bad coordinates for a few frames, possibly caused by some light leaking into the experimental setup that confused the tracking algorithms.

In either case, the procedural approach is to put CinePlex Editor into a state where the video is advanced frame-by-frame and enter new or replacement tracker coordinates by clicking in the Video window at the desired location.

Repairing tracking coordinates

1. In the Markers window, select the Coordinates marker to repair. Click Show. To minimize confusion during the procedure, clear Show for other Coordinate markers (if present).

2. For the following procedure to work, the Coordinates markers must be aligned to the Frame marker times by using the Snap-to Marker Occurrences dialog box, for more information, see “Snap-To Marker Occurrences” on page 111. Follow the procedure outlined in that section to align the Coordinate markers to the Frame markers.

3. Locate a section of time that has bad or missing values for the selected Coordinate marker that needs to be repaired. Pause the playback at the first frame with bad or missing coordinates.

4. From the Tools menu, click Options, and in the Options dialog box click the General tab. Make sure that the selection in the Number of Frames to Advance During Click-To-Add box is 1 (the default). Also, from the Animate menu, select Lock To Video Frames.

5. In the Input window, at Left-Click, click Insert. This “arms” CinePlex Editor to enter new (or replace existing) marker occurrences when clicking the left mouse button in the Video window.

6. Position the mouse cursor where the new (or replacement) coordinate needs to be and click.

The position is entered (or updated) and the video automatically advances by one frame.

7. Repeat Step 6 until all the coordinates are entered or repaired. Move the file forward to the next episode of bad tracking coordinates and repeat.

8. When finished, from the File menu, click Save. You may save and export the new or updated positions like any other marker data.

4.7.6 Simple Place Cell Analysis

Suppose it is suspected that a certain neuron seems to fire only when the rat is in his nest. As a procedural approach to test this hypothesis, a new Zone Interval marker could be defined that defines the boundaries of the rat’s nest. The
generated occurrences of this marker represent the intervals during which the rat was in its nest. NeuroExplorer could then be used to search for correlations between neural firing rates and this interval.

1. Advance the video until a frame shows where the outline of the desired Zone (the nest) is clearly visible.

2. Define a new Zone Interval marker (see Section 4.5.1, “Defining Markers” on page 98). Label it “Rat In Nest”. In the Define New Marker dialog box, click Generate Occurrences to open the Zones Editor dialog box (see “Zones Editor” on page D-50).

3. In the Coordinates of the Selected Zone area, click Add and then click the left mouse button repeatedly in the video window in order to define the outline of the nest. Before completely closing the contour, click the right mouse button, which closes the contour.

4. In the Coordinates Marker to use list, select the appropriate Coordinates marker, and click Generate Selected. This generates occurrences of the new “Rat In Nest” marker. Click Done to close the Zones Editor dialog box.

5. To inspect the “Rat In Nest” intervals, use the Find Marker Occurrences dialog box (see Section 4.5.5, “Operating with Marker Occurrences” on page 108) to quickly advance through all the occurrences of the “Rat In Nest” marker. It is also possible to use the Marker Occurrences window to remove any undesirable “Rat In Nest” occurrences.

6. From the File menu, click Export to NEX (see Section 4.7.2, “Denoting Interesting Behavior In the Video” on page 137) to write the data to a NEX file for subsequent analysis. The “Rat In Nest” marker shows up as an interval variable in NeuroExplorer.
Chapter 5
Recording Positional Data with CinePlex Tracking Option

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5 Recording Positional Data with CinePlex Tracking Option

5.1 Introduction to the CinePlex Tracking Option

This chapter describes the CinePlex® System Tracking Option, the experimental applications for which it can be used, and how to use it. The Tracking Option extends the capabilities of CinePlex Studio by enabling the computation and recording of positional data. The Tracking Option requires the CPT V3 license in addition to the CPX V3 (Studio/Editor) license.

The general procedure for using the Tracking Option is:

1. Position the camera(s) so that the desired physical experiment area is within the field of view of the camera
2. Define the shape of the arena for each camera
3. Select the tracking mode to be used - Object Contour, LEDs, Color Markers, or Extended Tracking of Color Markers
4. Set the parameters for the selected tracking mode
5. Perform a calibration of the dimensions in the arena
6. Set the location where the recorded files will be saved
7. Save the settings and layout
8. Synchronize the CinePlex and OmniPlex® Systems for recording
9. Start recording from the OmniPlex System
10. Stop recording at the OmniPlex System
11. If desired, retrack coordinate data in CinePlex Studio offline mode
12. If desired, rerecord synchronized files with CinePlex Editor

You can configure CinePlex Studio to capture video only (Audio Video Interleaved [AVI] files), track positions only (digital video tracking [DVT] files), capture video and track positions simultaneously, or create no files.

The tracking function can also be used in offline mode with existing pre-recorded files. In offline mode the tracking parameters can be set to values that are different than those used during the original recording, if any, and the system will retrack the video based on the new settings (see Section 5.16, “Video Playback and Rerecording In Studio Files (Offline) Mode” on page 203).

The CinePlex Studio default window layout will be sufficient for most instances. However, to load, change or save a window layout, see Appendix E-Navigating the Plexon User Interface.

Use the flowchart below to choose the concepts and procedures in this chapter that apply to your experiment.
5.1 - Concept
Introduction to CinePlex Tracking Option

5.2 - Concept
Setting up Cameras and the User Interface

5.3 - Concept
Navigating the Studio Main Window

5.4 - Concept
Understanding Tracking Windows and Arenas

5.5 - Procedure
Defining the Arenas

5.6 - Concept/Procedure
Selecting Tracking Mode and Tracking Settings

Which Tracking Method?

5.7 - Procedure
Object Contour Tracking

5.8 - Procedure
LEDs in Darkness with LED Tracking

5.9 - Procedure
LEDs in Darkness or Light, Extended Colors Tracking

5.10 - Procedure
Extended Tracking of Color Markers in Light

5.11 - Procedure
Tracking Color Markers (Legacy Capability)

5.12 - Procedure
Calibrating the Arena Dimensions

5.13 - Procedure
Recording Synchronized Video and Neural Data

5.14 - Concept
Monitoring Video During a Recording Session

5.15 - Procedure
Recording Video Without Neural Data

5.16 - Procedure
Video Playback and Re-recording in Offline Mode

5.17 - Concept
Additional File-processing Tools

5.18 - Procedure
Using the Extractor

Includes option for near infrared tracking
5.2 Setting Up Cameras and the User Interface

The procedures for setting up cameras and the user interface are the same as those used for the Tracking Option. See Chapter 3, Recording Video with CinePlex Studio.

**CAUTION**

Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.

5.3 Navigating the Studio Main Window

See the section Section 3.2, “Navigating the Studio Main Window” on page 29 for a basic description of the Studio main window, where you can view and modify CinePlex Studio settings before starting the recording session.

When the Tracking Option is present, there are additional toolbar options and panes, as shown in the image below.
5.4 Understanding Tracking Windows and Arenas

This section explains how the CinePlex System manages the video processing load by using system-generated tracking windows and user-defined arenas.

5.4.1 System-generated Tracking Windows

The system generates tracking windows to limit the processing and analysis of video data to a small portion of the video image, typically to the body contour of the animal or the color markers or LEDs mounted on the animal. This reduces the overall CPU load and allows tracking more colors. Tracking windows also reduce problems with unwanted parasite objects (for example, reflections).

Tracking windows are displayed as yellow rectangles in the video display, as shown in the image below.

![Tracking Windows Image]

Tracking windows can be made to appear by selecting the Tracking Window checkbox in the Visualization area of the Tracking pane, as shown in the image below.

Note: In Object Contour mode, the area will be labeled Whole Body Visualization. In LED mode, it is labeled LED Visualization, and in Color Markers mode it is Marker Visualization.
The system automatically sets the size of the tracking window to cover the whole object. Each object (whole animal, LED, or marker) has its own tracking window. The tracking window is repositioned automatically. A history of an object’s movement is used to predict its next position. If the object disappears because of occlusion by a cable or other means, its tracking window is moved according to the speed and movement direction in its most recently detected frames. If the system is tracking multiple LEDs or markers in single animal mode, the system will also use the positions of the found LEDs or markers to predict the position of the one that disappeared. If the object is not found after a certain number of frames, the size of the tracking window will be increased. If the object is not found within two seconds, the system switches to search in the whole frame (or within the arena, if an arena shape has been defined).

### 5.4.2 User-defined Arenas

You can define an arena for each camera image. Arenas reduce problems with unwanted reflections and parasite objects outside of the working area.

For accurate tracking, you should ensure that the ratio of the object size to the arena size is such that the system will be able to track the object. If the ratio is too
small (image size of the object less than a few pixels) the system will not be able to distinguish the object from noise. If the ratio is too large (more than 1/4 of the video image) the system will not track the object.

Using the tools provided by CinePlex Studio and the Tracking Option, you can draw an outline of the experimental arena over the video image. Once this outline is drawn, Studio ignores objects outside of the arena when processing the images. This results in lower CPU usage and reduces false object detections due to reflections and shadows. It also allows the experimenter to exclude areas of the image that have no relevance to the experiment. Arena tools allow drawing circles, ellipses, rectangles, and freehand objects. Arena logical operations (AND, OR, NOT, XOR) allow combining multiple arena shapes to produce a single complex arena shape.

**Example - Using Arenas to Exclude Reflections**

The following drawings show two examples of arenas (red rectangles) - one for LED tracking mode and one for Object Contour tracking mode. In each case, the reflections outside the arena are ignored by the CinePlex System.
Example - Using Arenas to Exclude Background Objects or Colors

If a background object (or background color) might interfere with the tracking function, the object (or color) can be removed from the arena. This will allow the system to track the animal correctly.

This image shows an animal to be tracked along with a background object of approximately the same color. The background object is larger than the animal and the system is tracking the background object (the red cross hair is centered on the object and the tracking window [yellow rectangle] is surrounding the object).

To avoid this situation, the experimenter can use one or both of the following tools:

• Define a specific arena shape in which to track
• Use background subtraction (discussed elsewhere in this chapter)
This image shows a defined arena (in green) that the system will use to track the animal. The arena excludes the background object, therefore the system will never lock onto the object by mistake.

Modifying Arenas In Offline Mode

If you transfer an AVI file to an offline analysis computer on which CinePlex Studio is installed, that file can be retracted with new or changed arenas.

**Note:** The standalone computer must have minimum memory, processor and instruction set to run CinePlex Studio efficiently. These requirements for offline operation are CinePlex Version 3 software and a license key that enables the desired capability. However, it is important to determine that the computer on which the installation will be done meets the minimum system requirements. In general, this means a computer has a dual core Intel processor operating at better than 3 GHz with 3 GB of memory, and an NVIDIA® GeForce® 9600 GT or better video card. Requirements that are more current are available from Plexon support (support@plexon.com).
5.5 Defining the Arenas

This section explains how to define an arena for each camera, beginning with Camera 1. One arena is allowed per camera.

**Adding the Arena for Camera 1**

1. In the Scenes tab for Camera 1, click the **Add arena (+)** button.

A Scenes settings pane is displayed, and the toolbar now displays active icons for shapes and logical operators.

### Logical operators:
- Union shapes (OR), Intersect shapes (AND),
- Subtract shapes (NOT), XOR shapes (Exclusive OR)

### Shapes:
- Circle,
- Ellipse,
- Rectangle,
- Polygon

**Note:** If additional CinePlex System options (for example, CinePlex Basic Behavior Option and/or CinePlex 3D Option) are installed, the window might contain additional tabs and toolbar icons. This chapter focuses only on the CinePlex Tracking Option.
2 One or more shapes can be added to the arena. To draw a shape, click the desired shape on the toolbar (Circle, Ellipse, Rectangle, or Polygon). For a circle, ellipse or rectangle, left-click and hold the mouse on a desired point on the image and move the mouse to size the arena.

**Note:** For a freehand polygon, click the left mouse button over desired points that will be the nodes of the polygon, and use a right-click to close the polygon. The shape can be moved or resized by left-clicking and dragging.

3 Multiple shapes can be drawn and logically combined to create an arena with a complex shape. After the first shape is drawn, draw a second shape as follows:

- Click on the **logical operator** that will combine the first and second shape.
- Then click on the icon for the second shape and draw the second shape.
- To view the combined shape more clearly, click on the **Fill** checkbox to select it.
The images below show examples of combined arena shapes. Tracking will only occur in the shaded regions.

Union shapes

Intersect shapes

Subtract shapes

XOR shapes
Arenas drawn from several shapes do not need to be contiguous (as was the case in the examples above). The image below shows an arena that contains noncontiguous shapes. Tracking will only occur in the shaded regions.

4 If desired, use the logical operator and shape icons multiple times to add and join several shapes to accurately define the arena.

5 To delete a shape, select the desired shape in the Arena pane (or in the Video pane) and press the Delete key on the computer keyboard. In the images below note that the rectangle is selected for deletion.
Adding Arenas for Additional Camera(s)

Repeat Step 1 through Step 5 for any additional camera(s) to be used in the experiment.

5.6 Selecting the Tracking Mode and Tracking Settings

This section assists you in selecting the tracking mode to use for the experiment. It also explains the purpose of two of the settings common to all tracking modes: **Threshold** and **PLX** buttons.

5.6.1 Tracker Toolbar

The Tracker toolbar (shown below) allows you to select the desired tracking mode. When one of the tracking modes is selected, the system tracks the position of subject(s) in the video images, in real time, and delivers the tracked position coordinates to the OmniPlex® System.

![Tracker Toolbar Diagram]

5.6.2 Understanding the Tracking Mode Options

The tracking modes are listed below.

**Note:** Only one tracking mode can be active at a time. Tracking modes cannot be combined.

- **Object Contour Tracking:** In this mode, CinePlex Studio analyzes the image to find a whole-body shape that corresponds to the desired object, and then computes (and tracks) the center of gravity of the shape.

- **Tracking LEDs:** In this mode, CinePlex Studio tracks up to three light emitting diodes (LEDs) on the subject or subjects being tracked.

- **Tracking Color Markers:** This mode of tracking is retained primarily for legacy purposes, for experimenters who have been using this mode and wish to continue doing so. It can be used in experiments requiring a small number of distinct reflective colors (typically up to five colors in a typical arena) with
good lighting. It is possible to track more than 5 colors, but only if the arena lighting is sufficient.

**TIP**

**Extended Tracking of Color Markers**

For new experiments, Plexon strongly recommends using the **Extended Tracking of Color Markers** mode rather than the Color Markers tracking mode.

- **Extended Tracking of Color Markers**: This is the recommended mode of color markers tracking for most applications. In this mode, CinePlex Studio tracks up to 12 reflective colors (tape or paint, for example) on the subject or subjects being tracked. The actual number of trackable colors depends on the colors themselves, their relative sizes, and the lighting within the arena.

### 5.6.3 Guidelines for Selecting the Tracking Mode

This section assists you in selecting the tracking mode to use for the experiment, and optimizing tracking parameters to suit the needs of the experiment.

The table below provides an overview of the recommended tracking mode to use under various conditions.

<table>
<thead>
<tr>
<th>Tracking Device to be Used on the Animal</th>
<th>Are LEDs the Brightest Spots in Arena?</th>
<th>Recommended Tracking Mode to Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>No LEDs. No colored markers</td>
<td>Not Applicable</td>
<td>Object Contour</td>
</tr>
<tr>
<td>LEDs</td>
<td>Yes</td>
<td>LED or Extended Tracking of Color Markers</td>
</tr>
<tr>
<td>LEDs</td>
<td>No</td>
<td>Extended Tracking of Color Markers</td>
</tr>
<tr>
<td>Colored markers</td>
<td>Not Applicable</td>
<td>Extended Tracking of Color Markers</td>
</tr>
</tbody>
</table>

In general, for a given experimental setup, only one tracking mode is optimal. The following guidelines help to determine which tracking mode to use.

- In general, the best tracking results occur when light-emitting diodes (LEDs) are attached to the animal. This is due to:
  - The relatively small size of the objects being tracked
  - The high intensity of colors against a dark or partially lit background
• The easiest way to use LEDs is to mount them directly on the animal headstage. Plexon offers headstages with LEDs mounted on them, such as the headstage shown in this drawing.

• To track not only position but head direction, use two or three LEDs.

• For LED tracking, the system finds the brightest spots on the image, and determines their positions in the color space. LED tracking mode is recommended when LEDs are to be tracked, and they are the brightest spots on the image and the rest of the image is dark. Check the Pure Colors option to cause the system to recognize Plexon standard red, green, and blue LED colors automatically. Otherwise, select the colors to track.

• Object Contour Mode can only track the “center of gravity” of one animal’s contour, therefore, Object Contour mode cannot be used with LEDs or multiple animals.

• If the experiment requires Motion Measure, which can be used for studies of freezing behavior, use Object Contour mode.

• If the animals are multicolored, especially with high-contrast colors (for example, Long Evans rats), Object Contour mode works best with a contrasting background color, such as red.

• Object Contour mode is more sensitive to changes in background and lighting conditions compared to the other tracking modes.

• In general, more effort is required to configure Object Contour mode to obtain optimal tracking results than is required for either LED or Extended Reflective Colors modes. This is because slight variations in background and lighting can cause the animal’s contour to vary slightly, even if the animal is not moving.

5.6.4 Understanding the Threshold Setting

All tracking modes have a user-configurable Threshold parameter that is used in the calculation the system performs to locate and track an object. The result of the calculation depends on [1] the contrast between the tracked object and the background, and [2] the Threshold value set by the user. For a general understanding of how the Threshold value affects tracking, see Section 5.7.2, “Setting the Threshold” on page 164. That section presents the Threshold concept from the point of view of Object Contour tracking mode, but the discussion applies to all tracking modes.
5.6.5 Sending Tracking Data to the OmniPlex System

The CinePlex System stores tracking data on the host computer in AVI and/or DVT files, as specified by the user. In addition, you can specify that the tracking data (X, Y coordinates as a function of time) from Camera 1 be sent to the OmniPlex System. The OmniPlex System incorporates this tracking data into the PLX files, which also contain the neural data. The procedure for sending tracking data from CinePlex to OmniPlex is included in the recording procedure, Section 5.13, “Recording Synchronized Video Tracking and Neural Data” on page 194.

To configure the CinePlex System to send tracking data to OmniPlex, click the appropriate PLX button(s) for Camera 1 in the CinePlex Studio configuration pane. The diagram below shows an example of PLX buttons. When a PLX button is selected, it turns orange; when it is not selected, it is clear.

The following conditions apply to the process of sending tracking data from CinePlex to OmniPlex:

- Data can be sent for Camera 1 only.
- Data can be sent in online (“Cameras”) mode only, not in offline (“Files”) mode.
- Data can be sent for up to three LEDs or colored markers. (Only three of the PLX buttons can be active simultaneously.)

The procedure for sending data is as follows:

1. Start the OmniPlex Server and PlexControl.
2. Start data acquisition in OmniPlex by pressing the Start Recording button on the PlexControl toolbar. (This step also causes the OmniPlex System to begin
5 Recording Positional Data with CinePlex Tracking Option

sending timing signals to the CinePlex System. Without this step, CinePlex cannot send data to OmniPlex.)

3 Start CinePlex Studio.

4 Verify that “Cameras” is selected in the Studio pulldown menu and that a camera image is displayed for Camera 1. (It is acceptable if other camera video images are also displayed, but Camera 1 is required.)

5 In CinePlex, load a settings file that contains tracking, or configure tracking. Ensure that at least one PLX button is pressed.

6 Arm CinePlex Studio (press the “A” arming button in the Studio toolbar).

Note: At this point, there is no tracking data being sent from CinePlex to OmniPlex. In the armed condition, CinePlex is waiting for a start signal to be sent from OmniPlex. The SPK - Activity pane in PlexControl shows no data on the CPX1 line.

7 Start recording by pressing the Start Recording button in PlexControl (Studio recording starts also). Studio starts sending the coordinate data to OmniPlex, and the SPK - Activity pane in PlexControl shows the synchronized data stream (see the blue data lines in the image below). Scroll to the bottom of the Activity window to show the CPX1 data row.

8 Stop recording by pressing the Stop Recording button in PlexControl (Studio recording stops also.)

Note: At this point, there is no tracking data being sent from CinePlex to OmniPlex, because CinePlex is once again in the armed condition. The SPK - Activity pane in PlexControl shows no data on the CPX1 line.

9 You can start and stop recording as many times as desired. When recording starts, tracking data will flow from CinePlex to OmniPlex. When recording stops, tracking data will not flow.

10 If you disarm CinePlex (by clicking the “A” arming button, tracking data will flow again from CinePlex to OmniPlex.

Note: Plexon recommends a short test recording to verify the data stream is being sent. The SPK - Activity pane in PlexControl should show the
presence of the data stream, similar to that shown in the PlexControl image above.

5.6.6 Tracking Parameters - List of Configuration Procedures

The following sections contain procedures that configure the tracking parameters for specific experimental applications. Select the appropriate procedure for your experiment:

- Section 5.7, “Object Contour Tracking” on page 161
- Section 5.8, “LEDs In Darkness with LED Tracking” on page 176
- Section 5.9, “LEDs In Darkness or Light with Extended Tracking of Color Markers Mode” on page 180
- Section 5.10, “Extended Tracking of Color Markers In Light” on page 181
- Section 5.11, “Tracking Color Markers (Legacy Capability)” on page 187

5.7 Object Contour Tracking

Object Contour tracking records coordinate data for the movement of an animal within an experimental arena without requiring LEDs or reflective color markers to be attached to the animal.

In Object Contour tracking mode, the system compares the color of the animal with the background color and any background objects. The image below shows a dark colored animal to be tracked on a light colored background and without any background object in the window. The background’s light color is uniform and provides a good contrast to the animal’s color.
The image below shows an example of a well defined animal contour generated by the CinePlex System.
5.7.1 Configuring Parameters for Object Contour Tracking

Perform these steps to select and configure Object Contour tracking.

1. Place the animal in the camera field of view.
2. At the camera lens, adjust the zoom, focus, and iris settings for the best picture quality. For additional guidance on camera setup and video quality, see Section 3.1, “Setting Up Cameras and the User Interface” on page 26.
3. To select the Object Contour tracking mode, click the appropriate icon on the Tracker toolbar.

4. Click the Tracking tab to display the tracking parameters. In the Whole Body Visualization group check Contour and Fill Contour so that the objects found by the system are visible.

5. In the video image, view the contour(s) of the object(s) that the system is tracking. If the contour of the tracked object is not well defined, follow the
5 Recording Positional Data with CinePlex Tracking Option

instructions in one or both of the following sections to obtain good tracking results:

- Section 5.7.2, “Setting the Threshold” on page 164
- Section 5.7.3, “Object Contour Mode Advanced Functions - Overview” on page 166

After the Tracking parameters are set as desired, click the Save Settings button ( ) on the toolbar, or, on the File dropdown menu, click Save Settings:

5.7.2 Setting the Threshold

CinePlex Studio can locate an object of a specified color by the color contrast between the desired color and the threshold setting. If the animal has good contrast relative to the arena image, and the background is uniform (that is, there are no other objects with similar contrast), adjust the Threshold setting in the Object Contour Tracker area to fill the whole image of the animal.

**Note:** If the background is not uniform or does not have good contrast with the animal, setting the Threshold parameter might not be sufficient for tracking. If this condition exists, perform the procedure in Section 5.7.5, “Background Subtraction” on page 169 to remove the background from the video.

The Threshold is set in the Object Contour Tracker group.
The image below shows an example of a well defined animal contour.

Use the guidelines below to adjust the **Threshold** setting.

If the threshold setting is too low, the image could be similar to the one shown below. It will probably be necessary to experiment with the setting to obtain the optimal value.

If the size of the found target object is larger than 1/4 of the frame area, there will be a red blinking message on the bottom of the screen notifying that the threshold is probably too low and both the Arm and Record buttons will be disabled.

After the Tracking parameters are set as desired, on the **File** menu, click **Save Settings**, or click the **Save Settings** button ( ) on the toolbar.
5.7.3 Object Contour Mode Advanced Functions - Overview

For some experimental arrangements, adjusting the Threshold setting is not, by itself, sufficient to obtain the desired tracking results. Additional adjustments may be needed. Object Contour mode includes optional advanced functions to handle special circumstances in the experimental environment. These functions are accessed in the Tracking pane.

Use one or more of the following procedures to improve tracking:

- Section 5.7.4, “Detail Filtering Adjustment” on page 167
- Section 5.7.5, “Background Subtraction” on page 169
- Section 5.7.6, “Close Contour Option” on page 173
- Section 5.7.7, “Motion Measure Option” on page 175
5.7.4 Detail Filtering Adjustment

Use Detail Filtering to remove small features of the image that distort the tracking results. For example, a long tail on a target animal can skew the centroid calculation; cables attached to the target can also skew the results. The Detail Filtering adjustment parameter, which has a range of 1 - 10, can remove progressively larger features. Use the lowest setting that provides adequate results for the experiment.

**To set the Detail Filtering Adjustment value**

1. In the Properties window **Object Contour Tracker** area, click **Show Contour**, **Fill Contour** and/or **Find All Objects** checkboxes, and view the video image.

   ![Image of Detail Filtering Adjustment](image.png)

2. Select **Detail Filter** in the **Contour Treatment** pulldown menu.
3 Click Detail Filter and set the slider to 2.

4 Observe the effect on the image. Set the Detail Filter slider to lowest setting that removes the undesirable features from the target image.

5 After the Tracking parameters are set as desired, on the File menu, click Save Settings, or click the Save Settings button ( ) on the toolbar.
5.7.5 Background Subtraction

If a background object (or background color) might interfere with the tracking function, the system can be configured to ignore the object (or colored area). This will allow the system to track the animal correctly.

This image shows an animal to be tracked along with a background object of approximately the same color. The background object is larger than the animal and the system is tracking the background object (the red cross hair is centered on the object and the tracking window [yellow rectangle] is surrounding the object).

To avoid this situation, the experimenter can use one or both of the following tools:

- Use background subtraction (discussed in this section)
- Define a specific arena shape in which to track (discussed elsewhere in this chapter)
Example - Using Background Subtraction to Exclude Background Objects

This image shows the background object with nothing else in the window. You can capture the image of this window to use for background subtraction.

This image shows the background object and the animal together after the user has configured the background subtraction function. Note that the system is tracking the animal, as indicated by the positions of the red cross hair and yellow rectangle and the contour around the animal.
**Example - Using Background Subtraction to Exclude a Low-Contrast Background Color**

Background subtraction will allow you to do body tracking even when there is a low color contrast between the animal and background, a condition which is seen in the following image.

![Example Image](image1.jpg)

**Example - Using Background Subtraction with a Multicolored Animal**

You will be able to track multicolored animals using Plexon’s special algorithm of background subtraction. In this case be sure that all colors contrast with the background color. You can use different background colors to try to improve the quality. For example, a brick red background works well for Long-Evans rats. Note that the contour encloses the complete animal.

![Example Image](image2.jpg)
To apply the Background Subtraction option

1. In the Object Contour Tracker area, ensure that the Contour and Fill Contour checkboxes are selected (so the object contour can be viewed in the Video pane later in this procedure).

2. Remove the animal from the tracking area.

3. Capture background image by clicking the Camera icon. The Use Background control will activate so that it may be clicked.

   ![Background Image Table]

<table>
<thead>
<tr>
<th>Background Image</th>
<th>No image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use Background</td>
<td></td>
</tr>
<tr>
<td>Threshold</td>
<td>128</td>
</tr>
</tbody>
</table>

4. Check the Use Background checkbox (see diagram above). Checking this box configures the system to subtract the background image from the video.

   **Note:** Pressing the eye icon brings up a window containing the latest background image. Pressing the scissors icon deletes the latest background image.

5. Replace the animal in the tracking area.

6. Adjust the Threshold (see diagram above) so the animal is detected and the animal's outline is filled in the Video pane (see Section 5.7.2, “Setting the Threshold” on page 164).

7. After the Tracking parameters are set as desired, on the File menu, click Save Settings, or click the Save Settings button ( ) on the toolbar.
5.7.6 Close Contour Option

The Close Contour capability causes the tracker to merge multiple objects in near proximity to each other into a single object. This can occur, for example, when a cable passes between the animal and the camera. Adjust the setting so that a single object is displayed. The image below is taken before the Close Contour setting is applied.

To apply the Close Contour option

1. Select Close Contour in the Contour Treatment pulldown menu.
2. Adjust the **Close Contour** setting until the image contour is closed.

The image below is taken after the **Close Contour** setting is applied.

3. After the Tracking parameters are set as desired, on the **File** menu, click **Save Settings**, or click the **Save Settings** button ( ) on the toolbar.
5.7.7 Motion Measure Option

CinePlex Studio Motion Measure is an Object Contour mode option that can be used for studies of an animal’s freezing behavior. Motion Measure is the normalized contour difference of the animal’s body computed on a frame-by-frame basis.

**Note:** The Motion Measure option must be included during a CinePlex Studio recording or re-recording session if you plan to analyze the data with the CinePlex Editor Freezing Detector function. See Section 4.6.1, "Using the Freezing Detector" on page 119.

If the Motion Measure checkbox is selected, CinePlex Studio writes the motion-measurement data for each video frame to the AVI and DVT files. If the PLX button beside the Motion Measure checkbox is selected, CinePlex also writes the data to the OmniPlex System.

**To apply the Motion Measure option**

1. On the Object Contour Tracker menu, double-click the Motion Measure checkbox to enable Motion Measure.

2. Click on the PLX button, if desired, to write Motion Measure data to the OmniPlex System. (The PLX button turns orange when selected.)

3. After the Tracking parameters are set as desired, on the File menu, click Save Settings, or click the Save Settings button ( ) on the toolbar.
5.8 LEDs In Darkness with LED Tracking

This section configures the CinePlex System to track colored LEDs in darkness with the LED tracking mode selected. Up to three different colored LEDs can be tracked.

In darkness, the LEDs are the brightest spots in the window, therefore, the LED tracking mode is excellent for this condition. The image below shows three LEDs being tracked in darkness.

5.8.1 Configuring Parameters for LED Tracking

Perform these steps to select and configure LED tracking.

1. Place powered LEDs in the camera field of view.
2. At the camera lens, adjust the zoom, focus, and iris settings for the best picture quality. For additional guidance on camera setup and video quality, see Section 3.1, “Setting Up Cameras and the User Interface” on page 26.
3. To select the LED tracking mode, click the appropriate icon on the Tracker toolbar.
4. Click on the Tracking tab in the Dynamic Configuration pane to view the Tracking parameters.
5. In the LED Visualization group check Contour and Fill Contour so that the objects found by the system are visible. These selections are common to all LEDs used in the experiment.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Contour</td>
<td>✓</td>
</tr>
<tr>
<td>Fill Contour</td>
<td>✓</td>
</tr>
</tbody>
</table>
6 Check the **Pure Colors** checkbox in the LED Tracker area. Checking this box causes the standard red, green and blue LED colors to appear in the **LED Colors** area in the Tracking configuration pane.

![LED Tracker](image)

**Note:** In **Pure Colors** mode, software is optimized for the red, green and/or blue LEDs supplied by Plexon.

7 Check each color to track in the LED properties area (LED 1, LED 2 and/or LED 3).

![LED Properties](image)

8 For each color checked in Step 7, check the **PLX** button, if desired, to send a copy of the tracking coordinate data to the OmniPlex System. (The **PLX** button turns orange when selected and clear when deselected.)

9 Change the **Threshold** (common to all LEDs) so that the correct objects are filled and outlined on the Video window. Their color crosses (representing the centers of gravity) should be centered on the correct objects.

![Threshold](image)

10 If pure colors do not give good results, use the pick-up tool to select the color from the video (see "Using the Color Pick-Up Tool with LED Tracking" below). Adjust the **Threshold** as needed.

11 After the Tracking parameters are set as desired, on the **File** menu, click **Save Settings**, or click the **Save Settings** button ( ) on the toolbar.
5.8.2 Using the Color Pick-up Tool with LED Tracking

This procedure explains how to use the color pick-up tool to adjust Color 1, Color 2, or Color 3 to match an existing color of an LED on the animal.

LED color shade selection is possible, but requires precision in the pixel selection process. This is because an LED image is a hot white center surrounded by pixels of varying shades of color. You must click on one of the pixels of the desired color, but not white.

1. To use the color pick-up tool on a specific LED, click on the Color Selection box for the color that is to be adjusted.

2. The image below shows a sample video window before clicking the Color Selection box.

3. In the Video window a square area surrounding the cursor displays as a magnified window. Move the magnified window over the area to be shown in
the Color Selection box. The image below shows the magnified cursor window in the lower left of the diagram - note the digitization of the area.

4 Position the crosshair over a representatively colored pixel. The Color Selection box displays the color of the pixel directly under the crosshair. The image below shows a red pixel under the magnified area.

**Note:** Be sure that the pixel is the dominant color of the LED, and not the white center of the LED.

5 Click the pixel.

6 The color of the corresponding color box in the properties window will be changed to that of the clicked pixel.

7 Change the Threshold (common to all LEDs) so that the correct objects are filled and outlined on the Video window. Their color crosses (representing the centers of gravity) should be centered on the correct objects.

| Threshold | 130 |

**Note:** For a general discussion of Threshold values, see Section 5.7.2, "Setting the Threshold" on page 164.
If the cursor does not track accurately with the threshold set to optimum, change the color or adjust the sharpness and saturation.

Repeat the steps in this section for any additional camera(s) to be used in the experiment.

After the Tracking parameters are set as desired, on the File menu, click Save Settings, or click the Save Settings button ( ) on the toolbar.

5.9 LEDs In Darkness or Light with Extended Tracking of Color Markers Mode

The CinePlex System can track colored LEDs in darkness or light with the Extended Tracking of Color Markers mode selected.

In darkness, the LEDs are the brightest spots in the window, therefore, the Extended Tracking of Color Markers mode works well for this condition. The system treats the LEDs as if they were reflective colors. The image below shows three LEDs being tracked in darkness.

In light, the LEDs might (or might not) be the brightest spots in the window. If the LED colors have sufficient brightness and contrast with respect to the background, Extended Tracking of Color Markers works well for this condition. The image below shows three LEDs being tracked in light.
Note regarding use of the color pick-up tool with LEDs

With the color pick-up tool, LED color shade selection is possible, but requires precision in the pixel selection process. This is because an LED image is a hot white center surrounded by pixels of varying shades of color. You must click on one of the pixels of the desired color, but not white.

To configure tracking of LEDs with Extended Tracking of Colors mode

Follow the same procedure as with Section 5.10, “Extended Tracking of Color Markers In Light” on page 181.

5.10 Extended Tracking of Color Markers In Light

This section configures the CinePlex System to track reflective colored markers in light with the Extended Tracking of Color Markers mode selected. Up to 12 different colored markers can be tracked.

The image below shows three reflective markers being tracked.
5.10.1 Enabling Extended Tracking of Color Markers In Light

Perform these steps to select and configure Extended Tracking.

1. Place the colored targets in the camera field of view.

2. At the camera lens, adjust the zoom, focus, and iris settings for the best picture quality. For additional guidance on camera setup and video quality, see Section 3.1, “Setting Up Cameras and the User Interface” on page 26.

3. To select the Extended Tracking of Colors mode, click the appropriate icon on the Tracker toolbar.

4. Click on the Tracking tab for Camera 1 in the Dynamic Configuration pane to view the Tracking parameters.

5. In the Marker Visualizations group check Contour and Fill Contour so that the objects found by the system are visible. These selections are common to all color markers used in the experiment.

6. In the Marker Colors and Additional Marker Colors areas, click the checkboxes to select the colors to be tracked.
5.10.2 Using the Color Pick-up Tool with Extended Tracking of Reflective Colors

This procedure explains how to use the color pick-up tool to adjust any of the tracked colors (Color 1 through Color 12) to match an existing color of a reflective color marker on the animal.

1. To use the color pick-up tool on a specific color, click on the Color Selection box for the color that is to be adjusted.

   ![Marker Colors Table]

2. The image below shows a sample video window before clicking the Color Selection box.

   ![Sample Video Window]

3. In the Video window a square area surrounding the cursor displays as a magnified window. Move the magnified window over the area to be shown in...
5 Recording Positional Data with CinePlex Tracking Option

the **Color Selection** box. The image below shows the magnified cursor window in the lower left of the diagram - note the digitization of the area.

4 Position the crosshair over a representatively colored pixel. The **Color Selection** box displays the color of the pixel directly under the crosshair. The image below shows a red pixel under the magnified area.
5  Click the pixel.
6  The color of the corresponding color box in the properties window will be changed to that of the clicked pixel.
5.10.3 Improve Tracking Efficiency with Tolerance Parameters

1. If necessary to improve tracking, adjust the H, S and V tolerances so there are no Intersects among the various colors.

2. Change the H, S and V Tolerance setting so that the correct object is filled and outlined on the Video window. The crosshair should be centered on the correct object.
   
   **Note:** Do not change the Adjust HSV settings manually. These settings were adjusted automatically by the system when you clicked the colored pixel in the earlier step.

3. If the above steps do not provide accurate visualization of the objects that need to be tracked, or do not eliminate all the Intersects, consider making some or all of the following additional adjustments and changes:
   - Use different marker colors, especially if two of the colors being used in the experiment are similar to each other.
   - Increase the lighting level in the experimental area, if possible.
   - Reduce the number of color markers being used in the experiment.
   - Increase the gain on the camera (although this will also increase noise).

   **Note:** The above list is intended as a general guide. If you need additional information on these adjustments, contact Plexon support.
4. After completing the previous steps, verify that the configured CinePlex Studio system looks similar to the following image, in which the system is set up to track three colors.

![Image of CinePlex system tracking three colors](image)

5. Repeat the steps in this section for any additional camera(s) to be used in the experiment.

6. After the Tracking parameters are set as desired, on the File menu, click Save Settings, or click the Save Settings button ( ) on the toolbar.

### 5.11 Tracking Color Markers (Legacy Capability)

This section configures the CinePlex System to track an animal with Color Markers tracking mode selected, and with any of the following experimental configurations:

- LEDs in darkness
- LEDs in light
- Reflective colored markers in light

**Note:** This mode of tracking is retained for legacy purposes only, for experimenters who have been using this mode and wish to continue doing so. In this mode, up to 5 colors can be tracked in the typical arena. It is possible to track more than 5 colors, but only if the arena lighting is sufficient. For new experiments, Plexon strongly recommends using the Extended Tracking of Color Markers, as described elsewhere in this chapter.

The images below show LEDs in darkness, LEDs in light, and reflective markers (respectively) being tracked.
5 Recording Positional Data with CinePlex Tracking Option
5.11.1 Enabling Color Markers Tracking Mode

Perform these steps to select and configure Color Markers tracking mode.

1. Place the colored targets in the camera field of view.

Perform these steps to select and configure Color Markers tracking mode.

1. To select the Color Markers tracking mode, click the appropriate icon on the Tracker toolbar.

The Tracking pane for the selected tracking mode displays in the Static Configuration pane.

2. In the Visualization group check Contour and Fill Contour so that the objects found by the system are visible. These selections are common to all color markers used in the experiment.

<table>
<thead>
<tr>
<th>Contour</th>
<th>✔</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill Contour</td>
<td>✔</td>
</tr>
</tbody>
</table>

3. Check the Default Colors checkbox in the Marker Properties area.
Check the color to track by clicking the corresponding checkbox. If any settings need to be changed for a particular color, click on the ‘+’ for that color. Adjust the Threshold of the selected color (see diagram below) so that the correct object is filled and outlined on the Video window and its color cross is properly centered.

Note: If working with default colors, the Threshold should be moved to lower values to provide stable tracking.

If the default colors do not give good results, select the color from the video. To do this, use the method described in Section 5.10.2, "Using the Color Pick-
up Tool with Extended Tracking of Reflective Colors" on page 183. Adjust the Threshold higher to find and track the object.

8 Repeat Step 5 through Step 7 for each color selected.

9 After the Tracking parameters are set as desired, on the File menu, click **Save Settings**, or click the **Save Settings** button ( ) on the toolbar.

### 5.11.2 Setting the Threshold

CinePlex Studio can locate an object of a specified color by the color contrast between the desired color and the threshold setting. If the marker has good contrast relative to the animal, adjust the **Threshold** setting in the **Marker Colors** area to fill the whole image of the animal.

The Threshold is set in the **Marker Colors** group.

![Marker Colors](image)

Use the guidelines below to adjust the **Threshold** setting.
If the threshold setting is very low, the image could be similar to the one shown below. It will be necessary to experiment with the setting to obtain the optimal value.

![Image of a low threshold setting]

If the size of the found target object is larger than 1/4 of the frame area, there will be a red blinking message on the bottom of the screen notifying that the threshold is probably too low and both the Arm and Record buttons will be disabled.

If the threshold is low, the center of gravity crosshair will exhibit jitter. Click the **Fill Contour** checkbox to view the contour that the system is tracking. The image below shows an example. There are several parasite objects that are being tracked in addition to the desired marker.

![Image of a low threshold setting with parasite objects]

Try to set the threshold so that the number of parasite objects is as few as possible.

There is an additional tool to use to check whether the threshold is set too low. To see all objects, click the **Fill All Objects** checkbox. As shown in the image
below, the system is tracking the correct object, but it is also wasting bandwidth analyzing a large number of parasite objects.

Note: The Fill All Objects function (which displays the blue objects inside the green rectangle in the above image) is automatically disabled when the recording starts, and these objects are not displayed during recording.

Increase the threshold to reduce the number of parasite objects. The image above shows the tracked object (in green), but the image also contains a large number of parasite objects (in blue). After you increase the Threshold value, there should be fewer parasite objects. The image below shows very few parasite objects and effective tracking of the desired object.

Increasing the threshold does not work in all cases. If the threshold is too large, the target object will be smaller.
After the Tracking parameters are set as desired, on the File menu, click Save Settings, or click the Save Settings button ( ) on the toolbar.

### 5.12 Calibrating the Arena Dimensions

In many experiments, it is useful to calibrate the video image so that sizes, positions and velocities are reported in the desired units of measure instead of pixels. See Section 3.3, “Calibrating the Arena Dimensions” on page 30 for the procedure.

### 5.13 Recording Synchronized Video Tracking and Neural Data

This section explains how to record video and tracking data that is synchronized with neural data from the OmniPlex System. This procedure requires starting and stopping the CinePlex Studio video recording process remotely from the OmniPlex System. This method of triggering the recording ensures that:

- The timestamps in the CinePlex and OmniPlex files are derived from the same clock
- The CinePlex and OmniPlex file start times and stop times are synchronized
- The CinePlex frame numbers, coordinate data and timestamps are synchronized

Simultaneous starting, stopping, pausing, and resuming of the neural data and video files is essential in helping the researcher correlate the behaviors captured in the video with the observed neural activity.

Although you may manually start, stop, pause, and resume recording an AVI file at any time in CinePlex Studio by simply clicking the appropriate toolbar buttons, this method will not record synchronized files, because it produces video files that do not have the same start time as the corresponding neural data files.

#### 5.13.1 Recording Procedure

Perform these steps to record synchronized video and neural data.

---

**CAUTION**

Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.

**CAUTION**

**Lighting Conditions**

If lighting conditions change enough during recording that ‘objects too large’ or some other condition occurs, the position data may be meaningless.
1 Ensure that the system is connected as described in Appendix A-Cabling Guide so that the clock and control signals can be sent from the OmniPlex System to the CinePlex Studio components.

Note: For more information on setting up and running the OmniPlex Server and PlexControl, refer to the OmniPlex instructions.

2 At the OmniPlex System chassis, turn the power on and start the OmniPlex Server and PlexControl.

3 If not already done, configure the OmniPlex System.

4 Click the Start Data button in the PlexControl toolbar so that neural data acquisition begins, and the neural data appears in PlexControl display.

5 Double-click the CinePlex Studio icon. Wait for the CinePlex Studio application main window to appear on the monitor.

Note: If Studio does not detect the OmniPlex clock, an error message will appear. If it does, see Appendix F-Troubleshooting.

6 Verify that “Cameras” is selected in the Studio pulldown menu and that a camera image is displayed for Camera 1. (It is acceptable if other camera video images are also displayed, but Camera 1 is required.)

7 If there is an appropriate file containing all the desired CinePlex settings (with the tracking function configured), load the file onto the CinePlex System using the Load settings icon ( ) on the main toolbar or the File/Load Settings menu selection.

8 Click on the Global Config tab in the static configuration pane to display the Global Config pane.

Note: This pane is the first an experimenter will normally use when setting up CinePlex Studio, but perhaps not very often after that. It contains settings that pertain to the frame rate to use when recording, image resolution (quality of recordings to make), compression bit rate, local file name, and whether the experiment involves one animal or many.

9 View the settings in the Global Config pane and modify any that need to be changed prior to starting the next recording session:
10 To browse for the desired file location (where the recorded files will be saved), click on the browse icon, which is the rectangle with three dots on the **Rec Folder** row of the Global Config tab.

11 When the **Browse for Folder** appears, use standard Windows® methods to select or create the appropriate folder. The factory default location for the Recording folder is C:\PlexonData or D:\PlexonData (if disk D is available).

When finished choosing or creating a storage folder, click **OK**.

**Note:** The location of the **Recording** folder is included in the Settings file (if you save a Settings file), and is restored when the Settings file is loaded. To save settings, click **Save Settings** on the **File** menu, or click the **Save Settings** button ( ) on the toolbar.

12 To view the CinePlex Studio time display, select the Source 1 tab in the Video 1 window, and view the digital video recording (**DVR**) section. (CinePlex Studio maintains a time code that tracks the time elapsed since the last time recording began.)

13 In the **Timecode** options, select the **In Video** checkbox to include the time. Choose a **Location** and a **Format** setting to configure the display.
For example, the following images show the time code in the **Upper Left** location in **SSSSS.SSS** and **HH:MM:SS.SSS** format, respectively.
5 Recording Positional Data with CinePlex Tracking Option

15 In the **Camera** area, adjust the controls to obtain an acceptable image on the screen. The specific controls vary depending on the camera model. Typical adjustments include **Gain**, **Auto White Balance**, **Brightness**, **Sharpness** and **Saturation**.

**Note:** You can also use other image quality settings. To evaluate image quality settings, manually collect a set of AVI files at different settings and use the file mode to determine a minimum acceptable image quality setting for the experiment.

**TIP**
**Reducing blurs and color streaks in the video**
If the experimental subject moves quickly, blurs and color streaks can appear in the video. Reduce or eliminate these problems by increasing the shutter speed. For more information, see “Shutter” under Section 3.2.3, “Source Pane Settings” on page 30.

16 In the digital video recording (**DVR**) area of the Sources pane, select the type(s) of output to create - video file (**AVI File**), text file with digital video tracking (**DVT File**) data, neither or both.

<table>
<thead>
<tr>
<th>Output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AVI File</td>
<td>✓</td>
</tr>
<tr>
<td>DVT File</td>
<td></td>
</tr>
</tbody>
</table>

**CAUTION**
**Save the AVI File**
It is *strongly* recommended that you save an AVI File for every experimental run, even if you are sending data directly from CinePlex to OmniPlex. (The AVI File is the default output type.) The AVI file is the originally recorded video of the experiment, and it can be retrieved and analyzed again. If you deselect the AVI File checkbox, the original video will not be saved.

**TIP**
**Timestamps, frame numbers and tracking data—DVT File**
The system will generate a digital video tracking (**DVT**) file if you select the DVT File checkbox. The DVT file will have frame numbers, timestamps and tracking coordinates.

17 You have the option to send tracking data from the CinePlex System to the OmniPlex System. To send tracking data, click the **PLX** button(s) in the Camera 1 pane for the type(s) of data to be sent. (If no **PLX** button is checked, no data will be sent to the OmniPlex System during the recording session.)

**Note:** When a **PLX** button is selected, it turns orange; when it is not selected, it is clear.
The following conditions apply to the process of sending tracking data from CinePlex to OmniPlex:

- Data can be sent for Camera 1 only.
- Data can be sent in online ("Cameras") mode only, not in offline ("Files") mode.
- Data can be sent for up to three LEDs or colored markers. (Only three of the PLX buttons can be active simultaneously.)

18 (Optional) If the arena dimensions have not yet been calibrated, the calibration can be done now. See Section 3.3, “Calibrating the Arena Dimensions” on page 3-30 for details.

19 Repeat Step 13 through Step 16 for any other cameras connected to the system.

20 From the CinePlex Studio toolbar, click the “A” arming button. A yellow flashing cassette icon appears on the status bar.

**Note:** At this point, there is no tracking data being sent from CinePlex to OmniPlex. In the armed condition, CinePlex is waiting for a start signal to be sent from OmniPlex. The **SPK - Activity** pane in PlexControl shows no data on the CPX1 line.

21 From the PlexControl toolbar, click the **Start Recording** icon. If PlexControl prompts for a file name, enter it.

PlexControl starts recording and displays status information about the neural data file on the PlexControl status bar; for information on the PlexControl status, see the OmniPlex System instructions.

CinePlex Studio automatically starts recording and displays information about the video file in the CinePlex Studio status bar.

The Studio status bar will display the amount of free space remaining on the drive selected.

**Note:** The system automatically checks that there is at least 10 GB of free disk space on the PC before it starts recording a file. The file size can grow to fill the space available, except that the system automatically stops recording the current file when the available disk space has been reduced to 10 GB.
5 Recording Positional Data with CinePlex Tracking Option

Studio starts sending the coordinate data to OmniPlex, and the **SPK - Activity** pane in PlexControl shows the synchronized data stream (see the blue data lines in this image):

![SPK - Activity Pane](image)

**Note:** Plexon recommends a short test recording to verify the data stream is being sent. The **SPK - Activity** pane in PlexControl should show the presence of the data stream, similar to that shown in the PlexControl image above.

22 To pause recording, click the PlexControl **Pause Recording** icon.

PlexControl pauses recording and displays status information about the neural data file on the PlexControl status bar.

CinePlex Studio pauses recording and displays information about the video file in the CinePlex Studio status bar. The status bar flashes green and gray to indicate that the recording is paused.

To resume recording, click PlexControl **Pause Recording** again.

23 To stop recording, press the **Stop Recording** button in PlexControl (Studio recording stops also.)

PlexControl stops recording to the neural data file, clears the recording information from the status bar, and saves the file as specified in Step 21.

CinePlex Studio stops recording and saves the video file(s) to the location that was specified as **Rec Folder** in the CinePlex Studio Global Configuration Pane. CinePlex Studio clears the recording information from the status bar and re-arms itself for the next recording session.

When Studio is armed, for efficiency it creates temporary files. When recording is started remotely (from OmniPlex), Studio writes to these temporary files. When recording is stopped, the temporary files are renamed, and new temporary files are opened in anticipation of a new recording session. The Studio Messages Pane displays information similar to the example below.
Note: At this point, there is no tracking data being sent from CinePlex to OmniPlex, because CinePlex is once again in the armed condition. The SPK - Activity pane in PlexControl shows no data on the CPX1 line.

24 You can start and stop recording as many times as desired. When recording starts, tracking data will flow from CinePlex to OmniPlex. When recording stops, tracking data does not flow.

25 To disarm CinePlex Studio, from the DVR toolbar, click Arm to clear. The status bar returns to the disarmed state.

TIP

Tracking Data - Add it in real-time or add it later

If the PLX button for the desired tracking data is pressed before the start of recording, as explained in the procedure above, CinePlex sends the tracking data to OmniPlex in real-time. If you forget to press a particular PLX button before starting recording, or want to press different PLX button(s) later, CinePlex Editor can be used to replay the PLX file and overlay the coordinate data.

26 To view the captured video file, browse to the file location and double click to open the file.

27 To transfer files to an analysis computer (if different than the recording computer), follow standard Windows procedures.

28 To view the neural and video files together, start CinePlex Editor by following the procedures described in Chapter 4, Processing Video Files with CinePlex Editor.

Note: You can also view just the video files by using CinePlex Editor, Windows Media Player® or CinePlex Studio on the analysis computer.
5.13.2 File Naming Procedure During and After Recording

During the recording process, CinePlex Studio creates temporary names for the AVI files. When the recording is stopped, Studio renames the files.

If there is only one camera connected to the CinePlex System:

- The format of the temporary files is yyyymmddnnn.avi
- The format of the renamed files is PLX_file_name.avi

If there are multiple cameras connected to the CinePlex System:

- The format of the temporary files is yyyymmddnnn_N.avi
- The format of the renamed files is PLX_file_name_N.avi

where:

- yyyymmdd is the year, month and day
- nnn is a 3-digit number, 001, 002, ... 999 assigned automatically by the system
- N is the camera number for which the file is created - 1, 2, ...
- PLX_file_name is the file name specified by the user on the OmniPlex System in Step 21 of Section 5.13.1, "Recording Procedure" on page 194.

Note: If Studio is armed on one day, but the start signal is not received until the next day, the temporary filename remains the one for the previous day.

5.14 Monitoring the Video During a Recording Session

The status bar in the CinePlex Studio main window displays information that allows the researcher to monitor the video recording process. See the section Section 3.5, “Monitoring the Video During a Recording Session” on page 51 for a description of this feature.

5.15 Recording Video without Neural Data (Used for Animal Training)

You can record video and tracking data without neural data. In this case, the OmniPlex System is activated only for the purpose of providing the required clock for the CinePlex System. This procedure requires activation of the OmniPlex data stream (which starts the clock), and then starting and stopping the CinePlex Studio video recording process locally on the CinePlex System. This method of triggering the recording is typically used during animal training, when no neural data is being collected.

See the section Section 3.6, “Recording Video without Neural Data (Used for Animal Training)” on page 52 for this procedure.

Note: In addition to the parameters configured in that procedure, you can also configure the Tracking Option parameters. If the Tracking Option is enabled
and the DVT file format is selected, the DVT file will contain the tracking coordinates.

5.16 Video Playback and Rerecording In Studio Files (Offline) Mode

CinePlex Studio can be used in offline mode to play back and rerecord video from existing files. The existing AVI and/or DVT files are the ones recorded previously by means of the procedure in Section 5.13, “Recording Synchronized Video Tracking and Neural Data” on page 194.

The procedure is the same as presented in Section 3.7, “Video Playback and Rerecording In Studio Files (Offline) Mode” on page 59.

5.17 Additional File-processing Tools

The following tools can also be used for processing of files:

- Use the CinePlex Studio Extractor to extract static and dynamic data from a Plexon AVI file for analysis with a database program such as Microsoft® SQL Server® or data processing tools such as Microsoft Excel®. See "Using the Extractor" (below).

- Use CinePlex Editor (or some other method) to match up the AVI file with its partner neural data file, or DVT file, or both, and analyze the data. See Chapter 4, Processing Video Files with CinePlex Editor.

- You can import and analyze the X, Y position data in PLX files with NeuroExplorer®, Version 3.088 or later. For details about NeuroExplorer, see www.plexon.com.

5.18 Using the Extractor

CinePlex Extractor is an offline tool that extracts desired static and dynamic data from a Plexon AVI file, placing it into Plexon Settings file format and/or formats suitable for use by database programs such as Microsoft SQL Server or data processing tools such as Microsoft Excel. See the section Section 3.9, “Using the Extractor” on page 70 for the procedure.

When the Tracking Option is installed, the Extractor dialog boxes and output files contain positional coordinates in addition to the basic Studio frame number and timestamp values. Examples of these dialog boxes and output files are shown below.
5 Recording Positional Data with CinePlex Tracking Option
5 Recording Positional Data with CinePlex Tracking Option
Chapter 6
Generating Events with CinePlex Basic Behavior Option

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6 Generating Events with CinePlex Basic Behavior Option

6.1 Introduction to the CinePlex Basic Behavior Option

This chapter describes the CinePlex® System Basic behavior Option, the experimental applications for which it can be used, and how to use it. The Basic Behavior Option extends the capabilities of CinePlex Studio and CinePlex Tracking Option. The Basic Behavior Option requires the CPB V3 license in addition to the CPT V3 (Tracking) and CPX V3 (Studio/Editor) licenses.

6.1.1 General Procedure

The general procedure for using the Basic Behavior Option is the same as that for the Tracking Option (see Chapter 5, Recording Positional Data with CinePlex Tracking Option), with the additional procedures described in this chapter. The additional Basic Behavior procedures include:

- Defining static and dynamic zones of interest within an experimental arena
- Defining zone sequences
- Monitoring objects traversing zones and sequences and generating logical and digital events
- Defining behavioral events from one or multiple cameras to generate logical events and electrical signals
- Recording and viewing real-time and offline information about behavioral events and tracked objects, including such attributes as speed, direction (vector), limb angles, presence in particular zones in the arena, proximity to other objects, sequence of zones visited.
- Monitoring vectors between objects and creating behavioral events when the objects are within/outside of a customer-defined angle and tolerance
- Monitoring animal head direction based on markers or LEDs on a headstage.
- Monitoring animal speeds to create digital events when the speed is over/under a user-specified threshold
- Accumulating and displaying behavioral event statistics

6.1.2 Terminology

The following terminology is useful in discussing behavior recording and tracking:

- Zones: A zone is a defined portion of the arena that has significance in an experiment. Many zones can be defined simultaneously. CinePlex Studio provides tools that allow you to draw zone outlines on top of the video image. These tools operate in the same way as the arena tools, allowing complex shapes to be created by means of logical operations.

Note: Complex zones can be created for either static or dynamic zones; see the definitions of static zones and dynamic zones, below.
• **Static Zones**: Zones that do not move with respect to the image or the arena are referred to as static zones. In general, they are used in object recognition experiments. For example, a static zone could be an area the animal should avoid to receive a reward or it could be an area the animal must traverse to receive the reward. It could even be one of the zones in a sequence of zones the animal should traverse.

• **Dynamic Zones**: A dynamic zone is a circular area around a marker or LED. In general, it is used to detect social interactions among animals. Dynamic zones are available for LED tracking mode, Color Markers mode and Extended Tracking of Color Markers mode. They are not available in Object Contour tracking mode.

• **Sequences**: A sequence is an ordered list of zones. Many different sequences can be defined.

• **Events**: Logical events can be defined so that, when an animal enters or leaves a zone, or completes a sequence, the event becomes true. Many events can be specified. Their current states are dynamically displayed in the Event Statistics pane. The system can generate electrical pulses or levels (high or low) based on logical event states or state changes.

• **Combination Events**: A combination event is an event that becomes true when two or more other events are true. The events used in a combination event can be generated from one or multiple cameras. This allows events to be generated by simultaneous occurrences in several different images, if desired.

### 6.2 Setting Up Cameras and the User Interface

The procedures for setting up cameras and the user interface are the same as those used for the Tracking Option. See Chapter 3, Recording Video with CinePlex Studio.

**CAUTION**

Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.
6.3 Navigating the Studio Main Window

See the section Section 3.2, “Navigating the Studio Main Window” on page 29 for a basic description of the Studio main window, where you can view and modify CinePlex Studio settings before starting the recording session.

When the Tracking Option and Basic Behavior Option are present, there are additional toolbar options and panes, as shown in the image below.

6.4 Defining Arenas and Configuring Tracking Parameters

The procedures for defining the arenas and tracking parameters are the same as those used for the Tracking Option. See Chapter 5, Recording Positional Data with CinePlex Tracking Option.
6.5 Configuring Zones, Sequences and Events for Basic Behavior

This section explains how to create and configure zones, sequences of zones, events and combination events.

You can specify values for behavioral events for tracked objects, including such attributes as speed, direction (vector), limb angles, presence in particular zones in the arena, proximity to other objects or sequence of zones visited. For example, the system can create a digital event when the animal’s speed is over/under a user-specified threshold, or the animal is within a user-specified distance of a certain point in the arena.

6.5.1 Before You Start

The procedures in Chapter 5, Recording Positional Data with CinePlex Tracking Option are required for configuring an arena for each camera. The arena must be configured and the Tracking Option must be configured before a zone can be created. The Basic Behavior Option is built on the Tracking Option.

6.5.2 Overview of Procedure

The procedure consists of the following tasks:

- Section 6.6, “Adding Zones (Static and Dynamic)” on page 211
- Section 6.7, “Defining Sequences of Zones” on page 216
- Section 6.8, “Defining Logical Events” on page 219
- Section 6.9, “Defining Combination Events” on page 227

6.6 Adding Zones (Static and Dynamic)

There are two types of zones, static and dynamic. Static zones are created by clicking the Static Zone icon and defining the shape, size and location of the zone in the video image. Dynamic zones are created by clicking the Dynamic Zone icon and selecting the LED or color marker around which to draw it.

**Note:** See “Terminology” on page 208 for definitions of static zone and dynamic zone. In general, static zones are associated with static objects in the arena and dynamic zones are associated with objects attached to the animal.
6 Generating Events with CinePlex Basic Behavior Option

6.6.1 Adding a Static Zone

1. On the Scenes tab click the Add static zone to current arena icon.

The parameters are displayed for the new Static Zone.
2 Select the drawing tool that makes the most sense for the zone that needs to be created.

3 Draw the zone outline over the image corresponding to the first physical zone of interest. For the image below a red circle was added.

4 Adjust size and shape so that the complete zone, and nothing else, is enclosed by the outline. For the image below, the circle was adjusted to fit around the clock by moving and adjusting the circle by the handles on the yellow square.

5 If a complex zone is desired, select a different drawing tool if needed, and the logical operator to be applied.

Note: Remember that complex zones can be created by applying logical operations to additional shapes as they are added to the zone. These
logical operations are selected from the Scenes toolbar:

For a detailed description of the logical operators, see Section 5.5, "Defining the Arenas" on page 152.

The image below shows an example of a complex static zone.

6 Repeat Step 1 through Step 5 for each additional zone to be defined.
6.6.2 Adding a Dynamic Zone

**Note:** Dynamic Zones are not available for the Object Contour Tracking option.

1. On the Scenes tab click the **Add dynamic zone to current arena** icon.

The parameters are displayed for the new Dynamic Zone.
2 In the **Available Objects** row, select the specific marker or LED on which the dynamic zone will be centered.

3 If necessary, adjust the values for the **Time Threshold** and **Radius** parameters.

4 Repeat **Step 1** through **Step 3** for each additional zone to be defined.

### 6.7 Defining Sequences of Zones

**Note:** Before defining sequences of zones, two or more zones must be defined.

**TIP**

To view all panes in the main window, reset to default layout

If some of the panes are not visible in the main window, it may be helpful to restore the default screen layout. From the **Window** dropdown list, select **Layout**, then **Reset to Default Layout**.

1 After two or more zones have been added, use the **Sequences** tab.
2 Click the **Add new sequence** icon to add a sequence. A new sequence is added to the pane.

3 Click the **Add zone to selected sequence** icon to add a zone to the sequence. A zone is added to the sequence.

4 Select available zones from the drop down list for the new sequence. The selected zone is displayed in the **Zone 1** setting.
5 To add a second zone, repeat Step 3 and Step 4.

The selected zone is displayed in the Zone 1 setting.

6 Repeat these steps for each additional sequence to be defined.
6.8 Defining Logical Events

Logical events can be defined as TRUE when an animal enters or leaves a zone or completes a sequence, or when a specified parameter (the angle between two vectors, the animal’s speed or the animal’s head direction) is within a specified range.

1. In the Events tab, select the Add new tracking event icon to create an Event.

2. In the Target row, select the type of Target behavior to be associated with the event.

The available parameters vary according to the type of Target selected.

The available Targets depend on the type of tracking:

- For Object Contour Tracking, the Targets listed in the dropdown are Zone, Sequence and Speed.
- For LEDs, Markers, and Extended Markers, the Targets listed in the dropdown are Zone, Sequence, Speed, Angle and Head Direction.

See the specific procedure for each type of Target:

- Section 6.8.1, “Events Based on a Zone” on page 220
- Section 6.8.2, “Events Based on a Sequence of Zones” on page 222
- Section 6.8.3, “Events Based on an Angle” on page 223
- Section 6.8.4, “Events Based on Speed” on page 225
- Section 6.8.5, “Events Based on Head Direction” on page 226
6 Generating Events with CinePlex Basic Behavior Option

6.8.1 Events Based on a Zone

1 Select a Zone.

2 Define the Condition.

The Present in Zone condition is dependent on the Time Threshold parameter that was set in the dynamic zone panel (Section 6.6.2, “Adding a Dynamic Zone” on page 215). Specifically:

- An object is considered present in a zone only when the zone wait time (the value of the Time Threshold parameter in the dynamic zones panel), in consecutive frames, has been satisfied.

- An object is considered absent from a zone in the first frame its coordinates are not in the zone.
**Note:** (The meaning of “object” is explained in the **Available Objects** discussion in the next step.)

3. In the **Available Objects** row, select a tracked object to traverse the specified zone.

![Event EV1.2](image1)

The event will become TRUE when the conditions are satisfied. At that point, the event count will be incremented and times and track lengths in the Event Statistics will be extended.

4. Event statistics can be viewed in the Event Statistics pane of the main window.

![Event Statistics](image2)
6.8.2 Events Based on a Sequence of Zones

1. Select a Sequence.

2. In the Available Objects row, select a tracked object to traverse the specified sequence of zones.

   The event will become TRUE when the conditions are satisfied. At that point, the event count will be incremented and times and track lengths in the Event Statistics will be extended.

3. Event statistics can be viewed in the Event Statistics pane of the main window.
6.8.3 Events Based on an Angle

This section explains how to define and specify values for behavioral events based on the angle between two vectors. The event is generated and recorded when the objects are within or outside of a user-defined angle and tolerance. For example, an event could be generated when the animal’s front leg is bent more than a certain angle.

The procedure for creating an angle-based event involves defining connections between pairs of markers (or LEDs) and then defining an angle between a pair of connections. In the example shown below, one connection is defined from the red marker to the green marker, and a second connection is defined from the red marker to the blue marker. Then the angle of interest (Angle Value) is specified as the angle those two connections, in degrees.

1. Add connections by clicking on the + icon in the Add/Remove Connections row.
2 Define two or more connections. In the example below, the user is defining four connections.

3 Specify the threshold angle **Value (degrees)** and the additional parameters in the **Event** group. In the example below, if the **Angle** is less than 60 degrees for at least one frame (the **Time Threshold**), the event becomes TRUE.

The **Color** selection (optional) defines the color the system will use to highlight the event in the Event Statistics frame, provided that the event becomes TRUE.

The **Available Objects** selection (optional) instructs the Event Statistics to display the track length of the selected object during the time that the event is TRUE.
When the event becomes TRUE, the event count will be incremented and times and track lengths in the Event Statistics will be recomputed and updated.

4 Event statistics can be viewed in the Event Statistics pane of the main window.

6.8.4 Events Based on Speed

1 Specify the Target as Speed.

2 Specify the speed (Value) and the Time Threshold and Condition, plus any additional parameters as needed in the Event group. In the example below, if Marker 1 moves faster than 10.0 cm/s for 5 frames the event becomes TRUE. Speed is recorded in pixels/second unless the camera is calibrated.

The Color selection (optional) defines the color the system will use to highlight the event in the Event Statistics frame, provided that the event becomes TRUE.

The Available Objects selection specifies the object to be tracked. The Event Statistics panel displays the track length of the selected object during the time that the event is TRUE.
6 Generating Events with CinePlex Basic Behavior Option

When the event becomes TRUE, the event count will be incremented and times and track lengths in the Event Statistics will be recomputed and updated.

6.8.5 Events Based on Head Direction

This section explains how to define and specify values for behavioral events based on the animal’s head direction as determined with markers or LEDs on the headstage. For example, an event could be generated when the animal’s head faces toward the feeding station (within a certain number of degrees).

1 In the Event tab, specify the tolerance (in degrees) and specify the markers or LEDs that identify the beginning and end of the head.
2 Specify the object of interest. In the example below, the feeder location is identified as Marker 3.

![Event EV1.1 diagram](image)

The meaning of these parameters is explained in the following diagram:

**6.9 Defining Combination Events**

1 Use the **Combination Events** tab.

**Note:** When two or more video sources are available, combination events can be created using events from multiple cameras. This is helpful, for example, for triggering an event when an animal is occupying a volume that has a different projection in each source. In the example below, the **Combination Events** tag is located in the Global Configuration pane; however, if desired, it can be repositioned in other panes, for example, the Video1 pane.
1. Click the **Add new combination of tracking events** icon.
2 Select the logical operation to use.

3 Select each event in the sequence from the drop down list of available events.

The system generates an entry in the Formula line based on the Operation and Event(s) that the user selected in the above steps.
4 If desired, an Event Combination can contain other Event Combinations, as shown in the following example.
6.10 Specifying Digital Outputs

You can specify creation of digital outputs for a logical event or combination event. Up to 24 different digital outputs can be specified, any of which can be pulsed, high, or low when the event occurs (i.e., when the event becomes TRUE).

Note: Digital outputs can be transmitted to external devices if the digital output (DO) unit is installed. (It is included with the Basic Behavior Option.) The DO unit connects to a USB port on the host PC. (Be sure to restart the CinePlex Studio application after connecting the USB cable.) The DO unit is shown below.

1. For events, open the Events tab.
2 To specify that a digital output is sent when an event occurs (becomes TRUE), select the desired output line from the drop down list associated with the event. The output line numbers correspond to the line numbers shown in the side view of the DO unit (see the photograph of the DO unit, above).

3 For event combinations, open the Combinations Event tab.
4. To specify that a digital output is sent when a combination event occurs (becomes TRUE), select the desired output line from the drop down list associated with the combination event.
6 Generating Events with CinePlex Basic Behavior Option

6.11 Calibrating the Arena Dimensions

In many experiments, it is useful to calibrate the video image for each camera so that sizes, positions and velocities are reported in the desired units of measure instead of pixels. See Section 3.3, “Calibrating the Arena Dimensions” on page 30 for the procedure.

6.12 Recording Synchronized Video Tracking and Neural Data

The procedure for recording video and neural data is the same as that used for the Tracking Option. See Chapter 5, Recording Positional Data with CinePlex Tracking Option.

6.13 Monitoring the Video During a Recording Session

The status bar in the CinePlex Studio main window displays information that allows the researcher to monitor the video recording process. See the section Section 3.5, “Monitoring the Video During a Recording Session” on page 51 for a description of this feature.

6.14 Recording Video without Neural Data (Used for Animal Training)

You can record video, tracking and basic behavior data without neural data. In this case, the OmniPlex® System is activated only for the purpose of providing the required clock for CinePlex. This procedure requires activation of the OmniPlex data stream (which starts the clock), and then starting and stopping the CinePlex Studio video recording process locally on CinePlex. This method of triggering the recording is typically used during animal training, when no neural data is being collected.

See the section Section 3.6, “Recording Video without Neural Data (Used for Animal Training)” on page 52 for this procedure.

Note: In addition to the parameters configured in that procedure, you can also configure the Tracking Option and Basic Behavior Option parameters.
6.15 Displaying Behavioral Event Statistics

To open the event statistics pane, select Event Statistics from the View pulldown menu.

The images below are examples of event statistics displays for sequence-based and angle-based events.

6.16 Video Playback and Rerecording In Studio Files (Offline) Mode

CinePlex Studio can be used in offline mode to play back and rerecord video from existing files. The existing AVI and/or DVT files are the ones recorded previously by means of the procedure in Section 6.12, “Recording Synchronized Video Tracking and Neural Data” on page 234.

The procedure is the same as presented in Section 3.7, “Video Playback and Rerecording In Studio Files (Offline) Mode” on page 59.

6.17 Additional File-processing Tools

Additional tools can be used for processing of files. See Section 5.17, “Additional File-processing Tools” on page 203.
### 6.18 Using the Extractor

CinePlex Extractor is an offline tool that extracts desired static and dynamic data from a Plexon AVI file, placing it into Plexon Settings file format and/or formats suitable for use by database programs such as Microsoft® SQL Server® or data processing tools such as Microsoft Excel®. See the section **Section 3.9, “Using the Extractor” on page 70** for the procedure.

When the Tracking Option and Basic Behavior Option are installed, the Extractor dialog boxes and output files contain positional coordinates and behavioral events data in addition to the basic Studio frame number and timestamp values. Examples of these dialog boxes and output files are shown below.
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6 Generating Events with CinePlex Basic Behavior Option
Appendix A
Cabling Guide

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A Cabling Guide

A.1 Overview

This appendix explains how to cable the Plexon CinePlex®/OmniPlex® System.

Plexon® hopes that this procedure solves cabling issues for most installations. Plexon welcomes feedback as to how to improve the experience. Please contact Plexon support (support@plexon.com or +1-214-369-4957) with comments.

The diagram below provides an overview of the required connections.

A.2 Required Cables

This section lists the cables required for connections between the CinePlex System and the OmniPlex System, and connections between the CinePlex System.

CAUTION

Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.
and the cameras. (The cables listed here are in addition to those needed for normal OmniPlex System operation, such as the cable that carries OmniPlex control and neural data.)

For installations that use one or two cameras without a CinePlex Trigger Controller unit

The following cables are used if one or two cameras are installed and there is no CinePlex Trigger Controller unit in the system.

- Universal timing cable between the TIM Cable Adaptor and the Access IO Adaptor (CinePlex DIO).
- Trigger cable(s) from the CinePlex Access IO Adaptor to the video camera(s).
- FireWire cable(s) from the FireWire card in the host PC to the video camera(s).

Note: Plexon supplies the Trigger and FireWire cables bundled together with plastic tie wraps. This combination is referred to as a Combination Cable on the following pages.

- Optional cable from a USB port on the computer to the Digital Output unit (for customers purchasing the Basic Behavior option).

For installations that use up to four cameras with a CinePlex Trigger Controller unit

The following cables are used if one or more (up to four) cameras are installed and there is a CinePlex Trigger Controller unit in the system.

- Universal timing cable between the TIM Cable Adaptor and the CinePlex Trigger Controller.
- Trigger Controller cable between the CinePlex Trigger Controller and the Access IO Adaptor (CinePlex DIO).
- Trigger cable(s) from the CinePlex Trigger Controller to the video camera(s).
- FireWire cable(s) from the FireWire card in the computer to the video camera(s).

Note: Plexon supplies the Trigger and FireWire cables bundled together with plastic tie wraps. This combination is referred to as a Combination Cable on the following pages.

- Optional cable from a USB port on the computer to the Digital Output unit (for customers purchasing the Basic Behavior option).

A.3 Cabling Procedure

This procedure explains how to connect the CinePlex/OmniPlex System cables.

1. Make sure that there is no power present at the connectors on the back of the host PC before connecting the combination Trigger and FireWire camera
A Cabling Guide

cable(s). Otherwise, the camera(s) could be damaged. To remove power from
the connectors on the host PC, simply shut down the host PC from the
Windows® Start menu.

CAUTION
Never plug or unplug a camera FireWire cable with the PC Power ON.
Permanent damage to the camera may result.

The following steps refer to diagrams that appear later in this appendix. Please
refer to the applicable diagram(s) when performing these steps. Use either Step 2
or Step 3, as applicable to the configuration of the system.

2 For installations that use one or two cameras without a CinePlex Trigger
Controller unit: Connect the Plexon supplied Universal Timing Cable and the
Sync Start Wire between the OmniPlex System and the Host PC.

3 For installations that use up to four cameras with a CinePlex Trigger
Controller unit: Connect the Plexon supplied Universal Timing Cable and the
Sync Start Wire between the OmniPlex System and the Host PC.

4 Attach the combination Trigger and FireWire camera cable(s).

5 Connect all of the other cables for the system as shown in the diagrams.

A.4 Cabling Diagrams and Connection Details

This section contains pictorial representations of the cabling for several typical
CinePlex/OmniPlex System setups:

- CinePlex/OmniPlex System with One Video Camera on page A-5
- CinePlex/OmniPlex System with Two Video Cameras on page A-6
- CinePlex/OmniPlex System with Three Video Cameras on page A-7
- CinePlex/OmniPlex System with Four Video Cameras on page A-8

Please contact Plexon with questions about the setup if it differs substantially
from those represented.
A.4.1 CinePlex/OmniPlex System with One Video Camera
A.4.2 CinePlex/OmniPlex System with Two Video Cameras
A.4.3 CinePlex/OmniPlex System with Three Video Cameras
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Combination cables (4)

Universal Timing Cable

CinePlex Trigger Controller

I/O Cable

Cameras (4)

OmniPlex System

PC Rear Panel

CinePlex/OmniPlex System Adaptor

Universal Timing Cable
A.5 CinePlex/OmniPlex System Cable Images

1. Universal Timing Cable

2. Combination Cable – Trigger and FireWire

IO Wire for CinePlex Trigger Controller
A.6 CinePlex Trigger Controller - Required for Three Or Four Cameras
A.7 Close-up Images of CinePlex/OmniPlex System Cables Installed

A.7.1 Connections to OmniPlex System

A.7.2 Connections to Video Camera
A.7.3 Connections to Computer

One Video Camera

- FireWire Cable
- Trigger Cable
- Access IO Adaptor
- Universal Timing Cable (to TIM Cable Adaptor)
Two Video Cameras

- Trigger Cables
- FireWire Cables
- Universal Timing Cable (to TIM cable Adaptor)
- Access IO Adaptor
Three Video Cameras

Rear view of host PC:

Front of CinePlex Trigger Controller with Connections for Three Cameras:
Four Video Cameras

Rear view of host PC:

Front of CinePlex Trigger Controller with Connections for Four Cameras:
Appendix B
Optimizing Camera and Lens Usage for the Experiment

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B Optimizing Camera and Lens Usage for the Experiment

B.1 Overview

This appendix provides details of camera and lens setup and usage. It is intended to assist the scientist in preparing the cameras and lenses for his or her experiment.

In any experiment where video is required, there is a physical area of interest in which it would be meaningful to record video. This area of interest can be a simple enclosure, a maze, a geometrical track, or any other area needed for the experiment. For video recording of behaving animals, this area of interest is known as the arena. The arena shape and size are critical in determining the lens used and the distance from the camera to the arena. Colors used and target visibility are also extremely important.

The sections that follow this introduction provide information about camera and lens selection, arena layout, and camera installation.

Plexon® hopes that this procedure solves these issues for most installations. Plexon welcomes feedback as to how to improve the experience. Please contact Plexon support at support@plexon.com or +1-214-369-4957 with comments.

B.2 Available Cameras

For CinePlex® Version 3, Plexon currently offers several AVT cameras and several lenses, both varifocal and zoom. The camera types are as follows:

- AVT Stingray (Type 1/2 CCD)
- AVT Guppy (Type 1/3 CCD)
- Pike (Type 1/3 CCD)

The setup of the camera, lens selection and distance from the experimental arena are discussed in the following section.

B.3 Camera Positioning and Lens Selection

This section provides a systematic procedure for determining the position of the camera and selecting the lens to use in an experimental arena.

Investigators may find that they need to compromise arena size and/or camera distance to accommodate the physical limitations of the camera/lens combinations. The limiting factors are that the lens must be able to focus the arena image and that the arena image should fill the screen. If the camera’s distance to the arena is fixed, the arena size must be kept within certain limits for
best results. Alternatively, if the arena size is fixed, the distance between the camera and arena must be kept within limits for best results.

1 Determine Optimal Arena Setups

Use the charts below to determine if a particular lens can be used with the current experimental setup. The area between the green and blue lines in the charts represents arena size and camera distance combinations that are acceptable for best results.

2 Determine the distance from the camera to the arena in meters

This distance should be as far as possible from the arena, while still close enough to allow the zoom function to fill the sensor with the arena image. Be sure to allow space for camera mounting. Find that distance on the X-axis (Camera Distance) of the Standard Varifocal chart.

3 Determine the size of the arena in meters

Imagine a circle, square or 4:3 rectangle drawn around the arena, completely enclosing it. The Arena Size in the charts above is the diameter of the circle, the side of the square, or the longer side of the 4:3 rectangle. Find that size on the Y-axis (Arena Size) of the Standard Varifocal chart.

4 Determine if the arena size and camera distance are optimal

If the (X,Y) position specified by the Camera Distance and Arena Size is in the area between the Green and Blue lines, the setup should yield optimal results.
B Optimizing Camera and Lens Usage for the Experiment

when the camera is zoomed appropriately. It is not necessary to proceed. The Standard Varifocal lens will work.

If the \((X,Y)\) position specified by the Arena Size and Camera Distance is NOT in the area between the Green and Blue lines, the setup is sub-optimal. The image will be smaller than desirable, larger than desirable, or out of focus.

5 If the position is not optimal, try the steps above on the chart for the Zoom lens

If this lens yields an optimal result, contact Plexon to obtain the lens. If not, try adjusting Arena Size and Camera Distance to find an optimal combination with one of the lenses.

6 If an optimal result cannot be obtained using this procedure, contact Plexon for other lens possibilities

Note: The charts are derived from calculated numbers. Small variations in lens and camera manufacturing can result in as much as 10% variation.

B.4 Experiment Design

B.4.1 Field of View

The field of view (what the sensor of the camera sees) depends on the distance between the camera and the surface and the angles of view of the lens that is used with the camera. The cameras supplied by Plexon generate screen images with the following geometries, depending on the camera model:

- images that are rectangular, 4 units wide by 3 units high, as shown by the diagram below. This aspect ratio corresponds to the sensor image size of 640 by 480 pixels or 320 by 240 pixels.
- images that are square, with sensor image size of 320 by 320, 640 by 640 or 960 by 960 pixels.

The example that follows in this section is based on a 4 by 3 rectangular geometry.

Orient the camera to the experimental area to take maximum advantage of the rectangular field of view. As shown in the following illustration, the 4:3 ratio
corresponds to a horizontal dimension (H) that is 1.33 times the vertical dimension (V).

When the camera is placed so that it is directed towards the experimental area, it has a horizontal angle of view and a different vertical angle of view because of the aspect ratio described above. The image producing sensor in the camera is also rectangular in the same proportion. So the ideal experimental layout will have a rectangular 4:3 arena with the camera aligned so that its longer (horizontal) sensor dimension is parallel to the arena’s long side. Actual arenas may not be 4:3 rectangles, but in all cases, best results will be obtained when the
longest dimension of the arena is parallel to the longer sensor dimension of the camera.

When the camera and lens are viewed as shown in the image below, the long axis of the sensor is in the horizontal plane. This axis should be parallel to the longest dimension of the experimental area.

The table below shows the horizontal and vertical angles of view that correspond with maximum and minimum zoom of the camera, using the standard lens as an example. Other lenses will differ.

<table>
<thead>
<tr>
<th></th>
<th>α (normal lens)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum zoom</td>
</tr>
<tr>
<td></td>
<td>(minimum angle</td>
</tr>
<tr>
<td></td>
<td>and area covered)</td>
</tr>
<tr>
<td>Horizontal</td>
<td>30 degrees</td>
</tr>
<tr>
<td>Vertical</td>
<td>22 degrees</td>
</tr>
</tbody>
</table>

The best way to avoid optical distortions is to set the lens at Maximum Zoom and move the camera far enough away from the experiment that the maze, cage, track or other setup is completely imaged. This is the optimum height. The figure below illustrates the parameters for a field of view estimate (maze size).
The formula to calculate the optimum height \( H \) of a camera over a square maze of side \( L \) (or a circular maze of diameter \( L \)) is:

\[
H = \frac{L}{2 \tan \left( \frac{\alpha}{2} \right)}
\]

If the maze is round or square, use the Vertical Maximum zoom angle (or 22 degrees for the normal lens). If the maze is rectangular, use the Horizontal Maximum Zoom angle (30 degrees for the normal lens).

### B.4.2 Colors

In contour tracking, to achieve the best tracking accuracy, choose colors with maximum contrast. For example, if the target animal is white, choose black or another dark color for the arena floor. Likewise, if the target is dark-colored, choose a bright white or other light color for the floor. For multi-colored animals like Long-Evans rats, red has been shown to have good contrast to the animal’s fur colors. It may be necessary to experiment to determine the best background color in individual situations.

In all tracking modes, use materials with solid colors as floors, if at all possible. Avoid floor materials with patterns or textures.

### B.4.3 Visibility

Unless otherwise required, the design of the arena should ensure that the target is completely visible to the camera in all areas. If the target is partially obscured by overhangs or other obstacles during its travel around the arena, the centroid calculations that determine target position and orientation can be affected.

### B.5 Camera Installation

#### B.5.1 The Plexon Camera Mounting Kit and Accessories

For repeatable, reliable video recording, the video camera(s) must be mounted stably and securely with respect to the experimental area. Cameras that vibrate or move can result in not just partial recordings or blurred images, but also in inaccurate position metrics, event triggers at undesired times, and, worst of all, non-repeatable experimental trials.

##### B.5.1.1 Plexon Mounting Kit

The Plexon mounting kit consists of both purchased and Plexon manufactured parts. It is included with CinePlex Version 3 and later cameras. The parts have been selected to apply in most of the situations encountered while doing CinePlex installations. Note that because of the general nature of the kit, not all parts will be used in all cases. In addition, there will be some cases where a particular installation will require that the customer purchase some additional parts locally.
B Optimizing Camera and Lens Usage for the Experiment

1 Mounting Bracket (Plexon 07-05-M-01)
2 Sandwich Plate (Plexon 07-05-M-02)
3 Three Arm Phenolic Knob (small) - 1/4”-20 (3 ea.) (McMaster Carr 57715K16)
4 Three Arm Phenolic Knob (large) - 3/8”-16 (McMaster Carr 57715K83)
5 Quick Change Mounting Assembly (Bogen-Manfrotto)
   a Rectangular Plate Adaptor (323)
   b Rectangular Plate (200PL)

B.5.1.2 Customer Supplied Parts as needed

The mounting kit does not include the small parts required for securing the mounting bracket to the desired surface. In those cases the customer will need to acquire the needed parts locally. Depending on the nature of the surface; screws, bolts, wall anchors, adhesive, or other items may be needed for a particular experimental setup. The customer should acquire these as needed.
B.5.1.3 Optional Mounting Accessories

Some experimental setups may require hard-to-find parts over and above those supplied in the Plexon Mounting Kit. Plexon has some optional parts available that can help provide secure mounting in many non-typical situations. See pages X and Y for some examples using these optional accessories.

1 Camera Mounting Plate 3x6” (Plexon 07-03-M-01)

2 Stud 036-014 (1/4”-20 m x 1/4” 20 f)(Bogen Manfrotto 036-014)*

3 Stud 036-038 (3/8” m x 3/8” f)(Bogen Manfrotto 036-038)*
4  Stud 037 (1/4”-20 m x 3/8” m)(Bogen Manfrotto 037)*
5  Stud 066 (1/4”-20 f x 2/8” f)(Bogen Manfrotto 066)*

6  Ball Head - Micro (Bogen Manfrotto 482)*
7  Ball Head - Mini w/ RC2 (Bogen Manfrotto 484RC2)*
8  Ball Head - Compact w/ RC2 (Bogen Manfrotto 486RC2)*

* Starred optional items are available from:
  • Plexon - please contact the Plexon salesperson
  • Online - search for “Manfrotto” and the item number from many sources such as:
    —  http://www.amazon.com/
    —  http://www.ritzcamera.com/
    —  http://www.bhphotovideo.com/
  • A local professional camera or video store

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**CAUTION ABOUT TRIPODS**

Note specifically that tripod mounting of the camera is NOT RECOMMENDED. This is because tripod adjustments, particularly leg locking mechanisms, can loosen and become unstable. Tripods can also be jostled or moved easily since they are generally not secured to a surface.

---

**B.5.2 Bracket Mounting Choices to Make**

First, choose where the camera should be mounted. Common choices are shown below:

**B.5.2.1 Above the Experiment**
1  Ceiling mount
2  Top of enclosure
   a  Inside of enclosure with room for cables
   b  Above the enclosure through an opening
   c  Inside of cage with room for cables

B.5.2.2 From the side of the Experiment
1  Wall mount
2  Side of enclosure
   a  Inside of enclosure with room for cables
   b  Outside of enclosure through an opening
   c  Inside of cage with room for cables

B.5.2.3 Below the Experiment
1  Up through a glass or cage floor to view the undersides of animals or for birds in perches
2  Floor mount aimed up an animals in the air or above the floor
3  Below enclosure
   a  Inside of enclosure with room for cables
   b  Below the enclosure through an opening
   c  Inside of cage with room for cables

B.5.2.4 Bracket Attachment Methods
Then, choose the most appropriate method of attaching the camera mounting bracket to the desired location.
On a surface of a wall or ceiling over 0.4 in (1 cm) thick, use one of the following methods or devise a custom method.

1. On a surface of a wall or ceiling over 0.4 in (1 cm) thick, use one of the following methods or devise a custom method.

   a. Customer provided screws through the three threaded holes in the bracket into the wall. Wall anchors should be used as necessary.

   b. Customer provided bolts through the three threaded holes in the bracket into a wooden surface. Pilot holes can be drilled, if needed, using the sandwich plate as a template.

   c. Customer provided adhesive or epoxy to glue the surface of the mounting bracket containing the three threaded holes to the surface.

2. On a cage:

   a. Place the sandwich plate on the outside of the cage, then

   b. Insert the three small knobs through the sandwich plate holes and through openings in the cage, then
3 On a wall or surface under 0.4 inches (1 cm) thick:
   a Drill three 9/32” (7 mm) holes using the sandwich plate as a template, then
   b Insert the three small knobs through the wall into the threaded holes in the mounting plate.
   c Thread the three small knobs into the threaded holes in the mounting plate.
B.5.3 Installing the Camera

Procedure for Camera Installation

1. Power down all system components - computer, MAP, etc.

2. Select the bracket attachment method suitable for the experiment and install the mounting bracket. Make sure that the mounting bracket is firmly attached and stable.

3. Install the rectangular plate adaptor on the mounting bracket using the large phenolic knob. For most applications, the point of large lever should be pointing away from the experiment when secured. Tighten finger-tight.

4. Make sure that the large lever on the plate adaptor is in the open position and ready to accept the plate. If the large lever cannot be moved easily, move the small brass level to the unlock position, and try again.

5. Remove any cables from the camera, if present.

6. Attach lens to camera by screwing it on finger-tight.
7 The tripod adaptor should already be attached to the camera - if not, do so at this time.

8 Attach the rectangular plate to the camera tripod adaptor. For most applications, the lens should be oriented in the position labeled “2 LENS”. Use the attached wire loop to finger-tighten the camera and then fold the loop down.

a Position “1 LENS” shown below

b Position “2 LENS” shown below
B Optimizing Camera and Lens Usage for the Experiment

9 Snap the camera/plate combination into the plate adaptor that is already attached to the mounting bracket. Note that there is only one possible orientation. The large lever will snap closed. Move the small brass lever to the lock position. Make sure that the large lever cannot be unlocked.

1 Attach the FireWire cable(s) to the camera(s). Use the FireWire socket labeled “1” in the photo.

2 Connect the other end(s) of the camera FireWire cable(s) to the FireWire board in the computer. The cable for Camera 1 should be connected to Port1 or Port2 on the FireWire board. If there is a second camera, it should be connected to Port3 or Port4. Tighten the screws so that each plug is secure in its socket.

CAUTION
Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.
3 Now connect the trigger cable(s) to the BNC connector on the AccesIO adaptor on the computer. If there are two cameras, a BNC T-adaptor will also be required.

4 Make sure all other system cables are attached as required. Apply power to all components, bring up the MAP Server and Sort Client and press the Start button on Sort Client. Bring up CinePlex and ensure that video is present. If not, go to the Troubleshooting section of the CinePlex manual and work through those procedures until a picture is present. If unable to get a picture, please contact Plexon support.

5 Loosen the large phenolic knob holding the camera/plate assembly to the mounting bracket and adjust the camera orientation until the experimental area is centered. Then tighten the large phenolic knob. It may also be necessary to repeat Step 8 with the camera in the “1 Lens” position of more adjustment latitude is needed.

6 Adjust the camera zoom until the experimental area fills the viewable image. If this is not possible the camera may need to be moved closer to or further away from the experiment. This can be done by selecting a different hole in the mounting bracket for the adaptor plate attachment. If there is space available, the mounting bracket may even be moved to the other side of its mounting surface. If a satisfactory view is still not possible, contact Plexon support for additional lens options.

7 Adjust focus, and iris as needed for a good image.

B.5.3.1 Mounting Options for Multi-camera Systems

Place each camera as needed to record its area of interest. Make the choices required for each position. Install each camera using the procedure.
B.5.4 Examples Using Optional Accessories

Some difficult mounting situations require the use of some of the optional mounting accessories mounted shown earlier. Here are some examples.

1 Using the optional Mini Ball Head between the camera and the mounting plate.

2 Using multiple ball heads to achieve difficult angles.
3 Using the Plexon camera mounting plate together with a ball head and stud 037 to achieve an offset camera mount at a difficult angle.

B.5.5 Camera Removal

Procedure for Camera Removal

1. Power down all systems.
2. Remove all cables from the camera.
3. Move the small brass level to the unlock position if not already there.
4. Place a hand on the camera to catch it as it releases.
5. Move the large lever to the unlock position.
6. Catch the camera and place it in a safe location.

B.6 CinePlex Screen Capture

It is possible to record the operation of CinePlex as well as other applications by the use of a screen capture program, such as Camtasia® Studio. The procedure below describes how to use a screen capture program to record the activities on the computer screen. For illustrative purposes, the procedure describes the use of Camtasia Studio. The procedure for using other screen capture applications would be similar.
1. From the **Start->All Programs** menu, locate the screen capture program and open it.

2. From the **Camtasia Recorder Capture->Input** menu select what to record.

3. Ensure **Camtasia Recorder** is minimized and hit the F9 key when ready to record.

4. When finished recording, hit the F10 key. A dialog box will appear to allow naming of the recorded file and also to decide where to store the file.

5. The recorded file will be saved as an AVI file in the directory specified and the file will be presented for viewing immediately after saving.
Appendix C
CinePlex Studio Messages

C.1 Types of Messages .......................................................... C-2
C.2 How to Use Messages ..................................................... C-2
C.3 CinePlex Studio Simple Messages ................................. C-2
C.4 CinePlex Studio Critical Messages ................................. C-7
C.1 Types of Messages

This appendix lists the system messages that the CinePlex® Studio software displays in reaction to current conditions and certain user actions. Messages are displayed in the Messages pane of the CinePlex System main window.

Informational messages are called simple messages, and the more urgent messages are called critical messages.

C.2 How to Use Messages

Messages provide a convenient flow of information to the user, and alert you to problems occurring within the CinePlex System. Therefore, messages can be useful for monitoring and troubleshooting the system. For information on correcting specific problems, see Appendix F-Troubleshooting.

C.3 CinePlex Studio Simple Messages

The table below lists the CinePlex Studio simple messages. In most cases, it is not necessary for you to take action when a simple message is displayed.

Note: In this table, [...] and <N> refer to text and numeric strings, respectively. These strings can differ for each instance of the message.

<table>
<thead>
<tr>
<th>Message #</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>C100</td>
<td>CinePlex Studio version [...] Starting...</td>
</tr>
<tr>
<td>C101</td>
<td>Current date:</td>
</tr>
<tr>
<td>C102</td>
<td>Date changed. Current date: [...]</td>
</tr>
<tr>
<td>C103</td>
<td>Current display frequency</td>
</tr>
<tr>
<td>C104</td>
<td>Display frequency successfully changed to &lt;N&gt; Hz</td>
</tr>
<tr>
<td>C107</td>
<td>Factory default settings loaded</td>
</tr>
<tr>
<td>C108</td>
<td>File opened for View</td>
</tr>
<tr>
<td>C109</td>
<td>File closed for View</td>
</tr>
<tr>
<td>C110</td>
<td>Cameras reset</td>
</tr>
<tr>
<td>C111</td>
<td>Frame resolution changed</td>
</tr>
<tr>
<td>Message #</td>
<td>Message Text</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>C112</td>
<td>Loaded settings were created for a different resolution. Arena, zones and calibration (if present) are properly resized.</td>
</tr>
<tr>
<td>C113</td>
<td>Startup settings loaded from [...]</td>
</tr>
<tr>
<td>C114</td>
<td>Settings loaded from [...]</td>
</tr>
<tr>
<td>C115</td>
<td>Background image loaded from [...]</td>
</tr>
<tr>
<td>C116</td>
<td>Settings stored in the file [...]</td>
</tr>
<tr>
<td>C117</td>
<td>Background image stored in the file [...]</td>
</tr>
<tr>
<td>C118</td>
<td>Play file started</td>
</tr>
<tr>
<td>C119</td>
<td>Event Combinations view presented</td>
</tr>
<tr>
<td>C120</td>
<td>Video view presented</td>
</tr>
<tr>
<td>C121</td>
<td>Recorder Properties view presented</td>
</tr>
<tr>
<td>C122</td>
<td>Area Properties view presented</td>
</tr>
<tr>
<td>C123</td>
<td>Messages view presented</td>
</tr>
<tr>
<td>C124</td>
<td>Previous video configuration is not applicable due to hardware changes or absence of Rasputin or OmniPlex key</td>
</tr>
<tr>
<td>C125</td>
<td>Video configuration has been automatically reset to One File</td>
</tr>
<tr>
<td>C126</td>
<td>The layout loaded contains panels incompatible with the current license. These panels are removed.</td>
</tr>
<tr>
<td>C127</td>
<td>Remote start received and discarded</td>
</tr>
<tr>
<td>C128</td>
<td>Remote stop received and discarded</td>
</tr>
<tr>
<td>C129</td>
<td>Remote pause received and discarded</td>
</tr>
<tr>
<td>C130</td>
<td>Video configuration has been automatically set to connect all available cameras according to the license</td>
</tr>
<tr>
<td>C132</td>
<td>Video configuration has been automatically set to One File</td>
</tr>
<tr>
<td>C133</td>
<td>Video configuration has been automatically reset to Camera 1</td>
</tr>
<tr>
<td>C135</td>
<td>Armed for remote control - DVR control by Plexon NDAQ is now enabled</td>
</tr>
<tr>
<td>C136</td>
<td>Remote control disabled - DVR control by Plexon NDAQ is now disabled</td>
</tr>
<tr>
<td>C137</td>
<td>Recording [...] started by Plexon NDAQ</td>
</tr>
<tr>
<td>C138</td>
<td>Recording [...] paused by Plexon NDAQ</td>
</tr>
<tr>
<td>C139</td>
<td>Recording [...] resumed by Plexon NDAQ</td>
</tr>
</tbody>
</table>
## Table 1: CinePlex Studio Simple Messages (Continued)

<table>
<thead>
<tr>
<th>Message #</th>
<th>Message Text</th>
</tr>
</thead>
</table>
| C140      | Recording [...] stopped by Plexon NDAQ (<N> dropped frame(s), <N> MQU)  
**Note:** MQU = maximum queued units. For a description of MQU, see “Monitoring the Video During a Recording Session” on page 3-51.  
C141      | Recording [...] started locally |
C142      | Recording [...] stopped locally (<N> dropped frame(s), <N> MQU) |
C143      | Recording [...] paused locally |
C144      | Recording [...] resumed locally |
C145      | Tracking switched to Object Contour mode |
C146      | Object Contour tracking stopped |
C147      | No LEDs are active. The objects for dynamic zones will be switched to N/A. |
C148      | Tracking switched to LED mode |
C149      | LED tracking stopped |
C150      | Can not switch to LED mode, since tracking license is not detected |
C151      | Tracking switched to Reflective Colors mode |
C152      | Reflective Colors tracking stopped |
C153      | Can not switch to Reflective Colors mode, since tracking license is not detected |
C154      | Recording [...] stopped due to missing license key |
C155      | Tracking stopped due to missing license |
C156      | No markers are active. The objects used in dynamic zones will be switched to N/A. |
C157      | Recording folder changed to [...] |
C158      | Recording [...] stopped since file size on FAT32 drive cannot exceed 4GB (<N> dropped frame(s), <N> MQU) |
C159      | Recording [...] stopped due to low disk space (<N> dropped frame(s), <N> MQU) |
C160      | End of File. Can not start recording |
C161      | End of File. Can not start playing |
C162      | Camera framerate changed to <N> |
C163      | Wizard opened |
C164      | Wizard finished |
C165      | CPX Studio window size reduced by Shrink button |
C166      | CPX Studio window size restored by Expand button |
<table>
<thead>
<tr>
<th>Message #</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>C167</td>
<td>Date has changed since the last file was recorded. The file number reset to 001</td>
</tr>
<tr>
<td>C168</td>
<td>Can not add sequence due to missing license key</td>
</tr>
<tr>
<td>C169</td>
<td>Tracking settings ignored since missing license</td>
</tr>
<tr>
<td>C171</td>
<td>Tracker Properties view presented</td>
</tr>
<tr>
<td>C172</td>
<td>New shape added to Arena</td>
</tr>
<tr>
<td>C173</td>
<td>New shape added to Zone</td>
</tr>
<tr>
<td>C174</td>
<td>Shape #&lt;N&gt; deleted from Arena</td>
</tr>
<tr>
<td>C175</td>
<td>Shape #&lt;N&gt; deleted from Zone</td>
</tr>
<tr>
<td>C176</td>
<td>Tracking Events view presented</td>
</tr>
<tr>
<td>C177</td>
<td>Event Statistics view presented</td>
</tr>
<tr>
<td>C178</td>
<td>Output lines for the loaded tracking events ignored since no digital output device found</td>
</tr>
<tr>
<td>C179</td>
<td>All shapes deleted from Arena</td>
</tr>
<tr>
<td>C180</td>
<td>All shapes deleted from Zone</td>
</tr>
<tr>
<td>C181</td>
<td>Temporary AVI file [...] renamed to [...]</td>
</tr>
<tr>
<td>C182</td>
<td>Renaming temporary AVI file [...] failed</td>
</tr>
<tr>
<td>C183</td>
<td>Temporary DVT file [...] renamed to [...]</td>
</tr>
<tr>
<td>C184</td>
<td>Renaming temporary DVT file [...] failed</td>
</tr>
<tr>
<td>C185</td>
<td>Standalone recording [...] started</td>
</tr>
<tr>
<td>C186</td>
<td>Standalone recording [...] stopped (&lt;N&gt; dropped frame(s), &lt;N&gt; MQU)</td>
</tr>
<tr>
<td>C187</td>
<td>Recording time zero [...] received from OmniPlex Server</td>
</tr>
<tr>
<td>C188</td>
<td>File N activated</td>
</tr>
<tr>
<td>C189</td>
<td>File N closed</td>
</tr>
<tr>
<td>C190</td>
<td>Zone Sequences view presented</td>
</tr>
<tr>
<td>C191</td>
<td>Standalone recording [...] paused</td>
</tr>
<tr>
<td>C192</td>
<td>Standalone recording [...] resumed</td>
</tr>
<tr>
<td>C193</td>
<td>Video Properties view presented</td>
</tr>
<tr>
<td>C194</td>
<td>Previous video configuration was [...]</td>
</tr>
<tr>
<td>C195</td>
<td>Switched to Camera mode</td>
</tr>
<tr>
<td>C196</td>
<td>Camera N started</td>
</tr>
<tr>
<td>Message #</td>
<td>Message Text</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>C197</td>
<td>Camera N stopped</td>
</tr>
<tr>
<td>C198</td>
<td>Switched to File mode</td>
</tr>
<tr>
<td>C199</td>
<td>Camera settings for camera &lt;N&gt; have been applied to all available cameras</td>
</tr>
<tr>
<td>C200</td>
<td>View with 3D calibration settings presented</td>
</tr>
<tr>
<td>C201</td>
<td>3D data view presented</td>
</tr>
<tr>
<td>C202</td>
<td>3D calibration started</td>
</tr>
<tr>
<td>C203</td>
<td>3D calibration finished successfully</td>
</tr>
<tr>
<td>C204</td>
<td>3D calibration failed</td>
</tr>
<tr>
<td>C205</td>
<td>3D calibration interrupted and not ready</td>
</tr>
<tr>
<td>C207</td>
<td>Video Edit view presented</td>
</tr>
<tr>
<td>C209</td>
<td>3D settings ignored since missing 3D license</td>
</tr>
<tr>
<td>C211</td>
<td>Initializing CinePlex</td>
</tr>
<tr>
<td>C212</td>
<td>Initializing cameras at start</td>
</tr>
<tr>
<td>C213</td>
<td>Disconnected from IP address</td>
</tr>
<tr>
<td>C214</td>
<td>Connected to IP address</td>
</tr>
<tr>
<td>C215</td>
<td>View with 3D settings presented</td>
</tr>
<tr>
<td>C216</td>
<td>Extended Color Markers tracking stopped</td>
</tr>
<tr>
<td>C217</td>
<td>Tracking switched to Extended Color Markers mode</td>
</tr>
<tr>
<td>C218</td>
<td>3D calibration failed: there are cameras without reference frame</td>
</tr>
<tr>
<td>C219</td>
<td>Temporary DV3 file [...] renamed to [...]</td>
</tr>
<tr>
<td>C220</td>
<td>Renaming temporary DV3 file [...] failed</td>
</tr>
<tr>
<td>C221</td>
<td>3D settings ignored due to mismatch between number of cameras used for this calibration and number of available sources</td>
</tr>
<tr>
<td>C222</td>
<td>No calibration data present</td>
</tr>
<tr>
<td>C223</td>
<td>Tracking settings ignored since they are incompatible with the current license</td>
</tr>
<tr>
<td>C224</td>
<td>Screen saver and power management disabled</td>
</tr>
<tr>
<td>C225</td>
<td>Screen saver and power management enabled</td>
</tr>
</tbody>
</table>
C.4 CinePlex Studio Critical Messages

The table below lists the CinePlex Studio critical messages. In most cases, it is important for you to take action (or revise your previous action) when a critical message is displayed.

Note: In this table, [...] and <N> refer to text and numeric strings, respectively. These strings can differ for each instance of the message.

Table 2: CinePlex Studio Critical Messages

<table>
<thead>
<tr>
<th>Message #</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>C898</td>
<td>MAP and CinePlex Studio out of synch.</td>
</tr>
<tr>
<td>C900</td>
<td>Clock signal not detected</td>
</tr>
<tr>
<td>C901</td>
<td>Clock signal detected</td>
</tr>
<tr>
<td>C902</td>
<td>Recording [...] stopped due to loss of clock OR RECORDING STOPPED AND/OR DISABLED! CLOCK or TRIGGER SIGNAL NOT DETECTED!</td>
</tr>
<tr>
<td>C904</td>
<td>Current CinePlex Studio does not support this version of settings file. Try to read another file.</td>
</tr>
<tr>
<td>C905</td>
<td>Can not be armed for remote recording before arena definition is finished</td>
</tr>
<tr>
<td>C906</td>
<td>Apparently Adobe Acrobat Reader is not installed on this system</td>
</tr>
<tr>
<td>C907</td>
<td>Cannot find the manual at: [...]</td>
</tr>
<tr>
<td>C908</td>
<td>Error code &lt;N&gt; has occurred while trying to open [...].</td>
</tr>
<tr>
<td>C999</td>
<td>Polygon can not have less than 3 points.</td>
</tr>
<tr>
<td>C910</td>
<td>Can not create self-intersecting polygons.</td>
</tr>
<tr>
<td>C911</td>
<td>Recording folder doesn't exist. Please choose another one.</td>
</tr>
<tr>
<td>C912</td>
<td>Saved layout does not exist</td>
</tr>
<tr>
<td>C913</td>
<td>Unable to load the requested layout! The default layout applied</td>
</tr>
<tr>
<td>C914</td>
<td>Can not be armed for remote recording until Wizard is exited.</td>
</tr>
<tr>
<td>C915</td>
<td>Can not start recording until Wizard is exited.</td>
</tr>
<tr>
<td>C916</td>
<td>Can not add new zone: number of zones of interest can not exceed 100.</td>
</tr>
<tr>
<td>C917</td>
<td>Can not add new zone: the boundary of the last existing zone is not defined.</td>
</tr>
<tr>
<td>C918</td>
<td>The number of shapes in arena can not exceed 100.</td>
</tr>
<tr>
<td>C919</td>
<td>The number of shapes in zone can not exceed 100.</td>
</tr>
<tr>
<td>C920</td>
<td>Overlapped zones are not allowed in sequence</td>
</tr>
<tr>
<td>C921</td>
<td>Can't delete selected zone since it is used for generation of tracking event(s). Modify the event(s) first.</td>
</tr>
<tr>
<td>C922</td>
<td>Can't delete selected zone since it is used in sequence(s). Modify sequence(s) first.</td>
</tr>
</tbody>
</table>
### Table 2: CinePlex Studio Critical Messages (Continued)

<table>
<thead>
<tr>
<th>Message #</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>C923</td>
<td>The number of events can not exceed 100.</td>
</tr>
<tr>
<td>C924</td>
<td>Can't delete the last remaining shape from the selected zone since it is used for generation of tracking event(s). Modify the event(s) first.</td>
</tr>
<tr>
<td>C925</td>
<td>Can not be armed for remote recording due to missing license key</td>
</tr>
<tr>
<td>C926</td>
<td>Can not add event since LED or Marker tracking mode is not selected.</td>
</tr>
<tr>
<td>C927</td>
<td>Can not add event since no LEDs selected.</td>
</tr>
<tr>
<td>C928</td>
<td>Can not add event since no markers selected.</td>
</tr>
<tr>
<td>C929</td>
<td>Can't delete selected sequence since it is used for generation of tracking event(s). Modify the event(s) first</td>
</tr>
<tr>
<td>C930</td>
<td>Unable to save current layout</td>
</tr>
<tr>
<td>C931</td>
<td>Can not add event combination since tracking mode is not selected.</td>
</tr>
<tr>
<td>C932</td>
<td>Can not add event combination since no single events are defined.</td>
</tr>
<tr>
<td>C933</td>
<td>Can not add new event combination since not all events for the last combination are defined.</td>
</tr>
<tr>
<td>C935</td>
<td>Can't uncheck selected LED since it is used for generation of tracking event(s). Modify the event(s) first.</td>
</tr>
<tr>
<td>C936</td>
<td>Can't uncheck selected marker since it is used for generation of tracking event(s). Modify the event(s) first.</td>
</tr>
<tr>
<td>C937</td>
<td>Can not add event since tracking mode is not selected.</td>
</tr>
<tr>
<td>C938</td>
<td>Can not add event since no LEDs selected</td>
</tr>
<tr>
<td>C939</td>
<td>Can not add event since no markers selected.</td>
</tr>
<tr>
<td>C940</td>
<td>No Rasputin or OmniPlex key found. Switching to offline mode</td>
</tr>
<tr>
<td>C941</td>
<td>Access I/O board is not found, but cameras are detected. Switch to test mode? Clicking YES will switch Studio to the test mode. Otherwise Studio will start in offline mode.</td>
</tr>
<tr>
<td>C942</td>
<td>Access I/O board is not found. Switching to test mode</td>
</tr>
<tr>
<td>C943</td>
<td>Access I/O board is not found. Switching to offline mode</td>
</tr>
<tr>
<td>C944</td>
<td>No clock signal from Plexon NDAQ, but cameras are detected. Switch to test mode? Clicking YES will switch Studio to the test mode. Otherwise Studio will start in offline mode.</td>
</tr>
<tr>
<td>C945</td>
<td>No clock signal from Plexon NDAQ. Switching to test mode</td>
</tr>
<tr>
<td>C946</td>
<td>No clock signal from Plexon NDAQ. Switching to offline mode</td>
</tr>
<tr>
<td>C947</td>
<td>Recording is stopped, since recordings longer than 1 min are not allowed in test mode</td>
</tr>
</tbody>
</table>
### Table 2: CinePlex Studio Critical Messages (Continued)

<table>
<thead>
<tr>
<th>Message #</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>C948</td>
<td>Can not add new sequence since the previously added sequence contains no zones.</td>
</tr>
<tr>
<td>C949</td>
<td>Can not add new sequence since the last zone in the previously added sequence is undefined.</td>
</tr>
<tr>
<td>C950</td>
<td>The number of sequences can not exceed 100.</td>
</tr>
<tr>
<td>C951</td>
<td>Can't delete selected sequence since it is used for generation of tracking event(s). Modify the event(s) first.</td>
</tr>
<tr>
<td>C952</td>
<td>Can not add new zone to the current sequence since the last zone in the sequence is undefined.</td>
</tr>
<tr>
<td>C953</td>
<td>Sequence can not contain more than 100 zones.</td>
</tr>
<tr>
<td>C954</td>
<td>Can not add new zone to the current sequence since no zones is defined.</td>
</tr>
<tr>
<td>C955</td>
<td>Files opened have different compression. Record, Play, Pause and Stop will be disabled.</td>
</tr>
<tr>
<td>C956</td>
<td>Files opened have different frame rate. Record, Play, Pause and Stop will be disabled.</td>
</tr>
<tr>
<td>C957</td>
<td>Can not open the same file twice.</td>
</tr>
<tr>
<td>C958</td>
<td>Start and end point of head direction vector should be different.</td>
</tr>
<tr>
<td>C959</td>
<td>Start point of head direction vector and end point of reference vector should be different.</td>
</tr>
<tr>
<td>C960</td>
<td>Can't associate selected LED with event since this LED is associated with dynamic zone used for generation of this event. Select another LED.</td>
</tr>
<tr>
<td>C961</td>
<td>Loading startup settings from [...] failed because this version of settings file is not supported by Current version of CinePlex Studio</td>
</tr>
<tr>
<td>C962</td>
<td>Current Cineplex Studio does not support this version of settings file. Try to read another file.</td>
</tr>
<tr>
<td>C963</td>
<td>Loading last saved settings file [...] failed because the file is missing. Factory default settings have been applied</td>
</tr>
<tr>
<td>C964</td>
<td>Settings loading failed because file [...] is missing. Factory default settings have been applied</td>
</tr>
<tr>
<td>C965</td>
<td>No settings file to load. Factory default settings have been applied</td>
</tr>
<tr>
<td>C966</td>
<td>Can not start recording due to missing license key</td>
</tr>
<tr>
<td>C967</td>
<td>Can not start recording since disk information can not be retrieved</td>
</tr>
<tr>
<td>C968</td>
<td>Can not start recording. File number can not exceed 999. Delete or rename video (*.AVI and *.DVT) files in the recording folder and try again</td>
</tr>
<tr>
<td>C969</td>
<td>Can not start recording due to low disk space.</td>
</tr>
<tr>
<td>C970</td>
<td>Can not add arena due combination to missing license key</td>
</tr>
</tbody>
</table>
### Table 2: CinePlex Studio Critical Messages (Continued)

<table>
<thead>
<tr>
<th>Message #</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>C971</td>
<td>Can't associate dynamic zone with selected LED since this LED is used for generation of event associated with this zone. Select another LED.</td>
</tr>
<tr>
<td>C972</td>
<td>Can't associate dynamic zone with selected Marker since this Marker is used for generation of event associated with this zone. Select another Marker.</td>
</tr>
<tr>
<td>C973</td>
<td>Only Motion JPEG RGB files are accepted. Record, Play, Pause and Stop will be disabled.</td>
</tr>
<tr>
<td>C974</td>
<td>Files opened have different frame resolution. Record, Play, Pause and Stop will be disabled.</td>
</tr>
<tr>
<td>C975</td>
<td>Only resolution 640x480 or 320x240 is supported. Record, Play, Pause and Stop will be disabled.</td>
</tr>
<tr>
<td>C976</td>
<td>CinePlex only supports MJPEG or Plex on MPEG4 AVI files. Try another file.</td>
</tr>
<tr>
<td>C977</td>
<td>Video frame width must be a multiple of 16. Record, Play, Pause and Stop will be disabled.</td>
</tr>
<tr>
<td>C978</td>
<td>Video frame height must be a multiple of 8. Record, Play, Pause and Stop will be disabled.</td>
</tr>
<tr>
<td>C979</td>
<td>CinePlex Studio has not been connected as a Client since SortClient is not running. No coordinate data will be recorded in .PLX file</td>
</tr>
<tr>
<td>C980</td>
<td>CinePlex Studio has not been connected as an OmniPlex Client since PlexControl is not running. No coordinate data will be recorded in .PLX file</td>
</tr>
<tr>
<td>C981</td>
<td>CinePlex Studio has not been connected as an OmniPlex Client since CinePlex.dll is absent or damaged</td>
</tr>
<tr>
<td>C982</td>
<td>Display resolution is not enough to run all available cameras even in 320x240 resolution. Number of cameras to use is reduced to fit the display resolution.</td>
</tr>
<tr>
<td>C983</td>
<td>Connections should be different.</td>
</tr>
<tr>
<td>C984</td>
<td>Connection points must be different.</td>
</tr>
<tr>
<td>C985</td>
<td>Open socket failed</td>
</tr>
<tr>
<td>C986</td>
<td>No network connection found</td>
</tr>
<tr>
<td>C987</td>
<td>Cannot connect to selected node.</td>
</tr>
<tr>
<td>C988</td>
<td>Cannot apply calibration: Number of cameras in the calibration file less than number of active cameras. Please try different calibration file or deactivate cameras.</td>
</tr>
<tr>
<td>C990</td>
<td>Camera switched to 320x320 resolution because of multi-camera license. One-camera license required to run 960x960 resolution for this camera.</td>
</tr>
<tr>
<td>C991</td>
<td>Cannot have resolution exceeding 320x320 because of multi-camera license. One-camera license required to run 960x960 or 640x640 resolution for this camera.</td>
</tr>
<tr>
<td>C992</td>
<td>Video signal detected</td>
</tr>
</tbody>
</table>
## Table 2: CinePlex Studio Critical Messages (Continued)

<table>
<thead>
<tr>
<th>Message #</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>C993</td>
<td>Video signal not detected</td>
</tr>
<tr>
<td>C994</td>
<td>This CinePlex Studio (N camera license) requires minimum w x h screen resolution or higher</td>
</tr>
<tr>
<td>C995</td>
<td>Cannot write to the file. The file might be opened by other application. Please close the file first</td>
</tr>
<tr>
<td>C996</td>
<td>This CinePlex Studio (N camera license) cannot accept W x H frame resolution</td>
</tr>
</tbody>
</table>
Appendix D
CinePlex Editor User Interface

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D CinePlex Editor User Interface

D.1 Overview

This appendix contains detailed reference information about menus, toolbars, dialog boxes, and windows for CinePlex Editor. By default, the Welcome To CinePlex Editor dialog box appears when CinePlex Editor starts. This dialog box provides streamlined access to operations that are also available under the File menu.

![Welcome To CinePlex Editor](image)

- **Start a New CinePlex Project** - This button starts the New Project Wizard, which assists in setting up a new CinePlex project. See “New Project” on page D-28.

- **Open an Existing CinePlex Project** - This button opens a file browser that allows selection of an existing CPJ file.

- **Open the Selected Recent CinePlex Project** - This button operates on the list box of the most recently used CPJ files. Select one and click Open the Selected Recent CinePlex Project to load that project. Alternately, double-click the project CPJ file in the list box to open it.

You can choose whether or not the welcomes dialog box appears after CinePlex Editor is started; to prevent the dialog box from appearing, click Do not show this dialog box on startup. To have the dialog box reappear, from the Tools
menu, click **Options**, click the **Display** tab, and select **Initially show 'Welcome To CinePlex' Dialog Box**.
D CinePlex Editor User Interface

D.2 Main Window

This section describes the CinePlex Editor Main window as shown below.

D.2.1 Video Window

The Video window by default is in the upper-right corner of the main window.

D.2.1.1 Function

The Video window displays the current frame of the video file. If the timecode and/or filename were inserted into the video, they are also displayed.
D.2.1.2 Features

Features of the Video window include:

- **Customizable Window** - You can customize the user interface. CinePlex Editor features a docking window architecture (see “Windows” on page E-6) that enables you to
  - float individual windows to any location
  - dock windows to various positions
  - close windows as needed
  - resize windows by clicking and dragging the splitter bars that divide them.

- **Resizable Video** - By default, the Video window stretches or shrinks the native video resolution (typically 640 X 480) to match the size of the Video window. You may also configure it to always show the video at its native resolution regardless of the size of the Video window by unchecking the **Resize Video to Fit Window** item on the right-click menu.

- **Coordinate Marker Crosshairs** - If coordinate markers are present with their **Show** checkboxes selected, the coordinates in effect for the current video frame appear as crosshairs superimposed over the video image. The crosshairs appear in the display color set for the coordinate marker. The range for coordinates is always (0,0) to (1023,767) with (0,0) being in the lower-left corner, regardless of the video resolution. Before plotting the crosshairs, CinePlex Editor scales the marker coordinates to the video resolution. Also, the coordinates that appear in the Video window are always those that are relevant for the frame in the display—not necessarily the selected marker occurrences. That is, if different coordinate marker occurrences are selected in the Marker Occurrences window, in general it does not change the coordinate crosshairs shown in the Video window. Note that if coordinates have not been computed or supplied for a frame, the values for the prior frame are used.

- **Grid Lines** - You have the option of showing grid lines overlaid on the video and also determining the spacing and color of the grid lines.

- **Tails** - While the video plays, it is possible to show the crosshairs with a tail line that shows the coordinate positions of previous frames. The length and width of this tail may be configured. By default, the tail changes color according to the age of the points. The tail color results from a blending of the marker color with another specified color; the blending amount increases for older points. If a **Fade-to Color** similar to the background color of the video is chosen, a fading effect is created that makes the tail appear to fade away. If the current time frame is rapidly advanced by using either the find functions or the Activity window scroll bar, CinePlex Editor can produce a confusing display for the rendered tails. In this case, from the right-click menu, select **Clear Tails** to erase the tail. Also, you may draw a complete version of the
tail by selecting **Show Complete Tail** from the right-click menu. The **Show Complete Tail** feature is useful, for example, for determining the locations visited by the tracked animal. If the mouse pointer is moved outside of the Video window, the complete tail is erased. This menu item shows a line connecting the coordinates for all marker occurrences for the Coordinates marker, as shown in the following image:

![Image showing a line connecting coordinates for the Coordinates marker]

**D.2.1.3 Video Right-click Menu**

The right-click menu allows changing of the behavior of the window, which includes controlling the tail rendering and stretching the video. Click the right mouse button to open the right-click menu for the Video window:

- **Resize Video To Fit Window** - When checked, this item resizes the video to fit the **Video** window. When unchecked, the video appears at its native resolution regardless of the size of the **Video** window.

- **Clear Tails** - Clicking this item clears the tails from the video window if the **Render Tails** checkbox has been set on the **Video View Properties** dialog box.

- **Show Complete Tail** - Clicking this item shows the complete tail from the whole video file if the **Render Tails** checkbox has been set on the **Video View Properties** dialog box.

- **Properties** - Clicking this item opens the **Video View Properties** dialog box. The properties are discussed below.
— **Resize Video to Fit Window** - This item stretches or shrinks the video to fit the size of the Video window. If not checked, the video is shown at its native resolution of 640x480 pixels.

— **Rendering** - This area contains items that controls how the video is presented in the Video window:
  
  — **Coordinate Marker Crosshairs Size** – This item controls the size of the crosshairs drawn at the current Coordinates marker position.
  
  — **Draw Grid Lines** – This item draws a grid of lines over the Video window.
  
  — **Spacing** – This item controls the spacing of the grid lines, which appear in Coordinates marker units of (0,0) to (1023,767).
  
  — **Color** – This item controls the color of the grid lines. Select a color from the drop-down list.

— **Tails** - This area contains items that control the appearance of the tracking tell tails:
  
  — **Render Tails** – This item toggles on or off the rendering of the tails that show previous Coordinates marker positions.
  
  — **Length** – This item controls the length of the tails, which is measured by the number of previous positions that appear in the window.
  
  — **Line Width** – This item controls the width of the line used to draw tails, which is measured in marker occurrences.
  
  — **Fade** – This item controls whether or not the tail fades away.
  
  — **Fade-to Color** – This item controls the color to which the tails fade. Fading occurs as follows:
The color drawn at point $p$ in the tail, where $p = 0$ for the current position and $p = L$ (Length) for the oldest position is:
the rendered color at $p = (p/L) \times FC + (1-(p/L)) \times DC$

where

$DC = \text{display color for the current Coordinates marker}$

$FC = \text{Fade-to Color}$

— Previous Position Dots Along Tails — This area contains the items that control the rendering of the small dots that indicate the previous positions:

- **Color** — This item controls the color of the small dots at the coordinates of previous marker occurrences.

- **Size** — This item controls the size in marker occurrences of the small dots at the coordinates of previous Coordinates marker occurrences.

- **Draw Every** — This item controls a factor that only draws a dot at every $Nth$ previous position.

- The image below shows a segment of the Video window with larger previous-position dots and **Draw Grid Lines** enabled.
D.2.2 Activity Window

In many ways, the Activity window is the heart of CinePlex Editor. The default docking position is at the bottom of the main window. This truncated view shows each important item or area in the Activity window.

D.2.2.1 Function

The Activity window displays markers and marker occurrences against their associated timelines.

D.2.2.2 Features

This section describes the various elements in the Activity window as shown in the illustration above.

- **Channel Zoom Controls** - The vertical zoom buttons appear at the left side under the top banner of the Activity window, as the image below shows. Click + to vertically zoom in on the display so that fewer time-lines appear, but each time-line is taller. This is the equivalent of selecting **Zoom In to Show Fewer Time-lines** from the right-click menu. Click — to zoom out, which is the equivalent of selecting **Zoom Out to show More Time-lines** from the right-click menu. You can also vertically scroll the time-lines in any of the following ways:
  
  — If the mouse has a wheel, by rotating it. This works when the mouse pointer is positioned anywhere inside the Activity window.
By pressing the PAGE UP or PAGE DOWN keys
— By dragging in the vertical direction in the label area

• **Marker and Unit Labels** - A label for each time-line appears on the left side of the Activity window. You can resize the label area by dragging the dividing line between it and the rest of the window. By default, CinePlex Editor selects the **Automatically Adjust Label Area Width** item in the right-click menu, which means that the dividing line continually adjusts so that the labels fit into the label area. To keep the size of the label area constant, click to clear the **Automatically Adjust Label Area Width** item in the right-click menu; this means the beginning of larger marker names can get truncated. If the divider line is dragged, CinePlex Editor automatically clears the **Automatically Adjust Label Area Width** item.

• **Time Range Zoom Controls** - The bottom of the Activity window contains the **Zoom Out** button, the **Zoom In** button, and the scrollbar for expanding, contracting, and moving the time range displayed by the Activity window. Each end contains boxes showing the current minimum and maximum extents of the displayed time range in seconds.

• **Time Range Scroll Bar** - Use the scroll bar at the bottom of the display to move the time span of the display. When the scroll bar is moved, the video frame that appears in the Video window is always updated to remain synchronized with the Activity window.

• **Times of Unit Firings, Marker Times** - The central area of the Activity window shows the times of marker occurrences and unit firings as colored tick marks that are arranged along horizontal time-lines. By default, CinePlex Editor provides a horizontal time-line on the display for each marker or spike channel whose **Show** column is checked in the Markers window or the Channels window. The color of the marker ticks results from the display-color setting in the Markers window. The colors of the tick marks on the time-lines for spike channels correspond to the unit classification of each spike. You can set the colors to associate with each unit; to do so, from the **Tools** menu, select **Options** and click the **Colors** tab. Also, if their respective **Show** column in Channels window is checked, CinePlex Editor provides line traces on the display for continuous data channels. To improve clarity, the Activity window devotes twice as much vertical space to the continuous data channels than it does to the marker or spike channels. You can drag the dividing line that separates the central area from the top banner. You can also drag a selected marker occurrence to a different time. To drag a marker occurrence to a new time, hold down the **SHIFT** key, click the marker occurrence, and
drag it to a new time. For Interval-type markers, the start and end times may be independently adjusted. For more information on the Activity window, see “Selecting and Editing Marker Occurrences” on page 114. When CinePlex Editor is appropriately configured, click the mouse in the Activity window to perform the following actions:

— Select the marker occurrence for the currently selected marker nearest in time (default). Double click to select a new current marker.
— Add a new marker occurrence
— Change the timestamp of an existing marker occurrence

• **Current File Position** - The top banner contains the *now* triangle, which denotes and displays the current time (or current file position). The current time indicator (*now* triangle) is the white triangle in the following image. The current time \( t \) in seconds appears to the left of the triangle, and the current video frame \( F \) number appears to the right of it. By default, CinePlex Editor positions the triangle in the center of the Activity window, but it can be dragged to a new location in the top banner. This causes the Activity window to display an asymmetric range for the activity surrounding the triangle. For example, from 1 second before to 3 seconds after the triangle position. You can control the time range shown. The range surrounds the current time, which is denoted by the small triangle at the top of the display. The text next to the triangle shows the current time (in seconds) and the current frame number. You can click and drag the current time triangle to a different position within the window of time shown.

![Current File Position](image)

**D.2.2.3 Activity Right-click Menu**

The *Activity* window has many options that can be controlled by using the right-click menu.

![Activity Right-click Menu](image)
• **Automatically Adjust Label Area Width** - This item causes the dividing line between the labels on the left and the central portion of the view to automatically adjust to accommodate the longest marker name.

• **Show Unsorted Spikes** - Selected by default, this item shows tick marks for unsorted spikes in the color chosen to represent unsorted spikes, or else the spikes do not appear.

• **Hide Invalidated Spikes** - Selected by default, this item hides tick marks for invalidated spikes; clearing this item causes tick marks to appear in a dark grey color.

• **Show All Units for a Channel on One Time-line** - Selected by default, this item plots each spike channel with a single time-line, and plots spikes with different units from that channel on the same time-line, but with different colors according to their unit classification. Clearing this item causes each unit to appear on a separate time-line. The channel name plus a letter of the alphabet denoting the unit appear as a label for the per-unit timelines. That is, if the channel sig001 has two defined units and some unsorted spikes and if **Show Unsorted Spikes** is checked, there are 3 timelines for that channel, which appear as sig001U (unsorted), sig001a, and sig001b.

• **Show Markers Across All Time-lines** - Normally, each marker appears as its own time-line in the display. Select this item to make each marker appear as a vertical line drawn across all of the other channels. This arrangement makes it somewhat easier to tell when marker occurrences happened with respect to spikes. The following image shows the **Activity** window with the **Show All Units for a Channel on One Time-line** item cleared and the **Show Markers Across All Time-lines** item selected:

![Activity Window](image)

• **Show Markers On Top Time-lines** - Selected by default, this item shows the time-lines for the markers at the top of the view, before the spike or continuous channel time-lines. Clearing this item causes the marker channels to appear at the bottom. This item is only relevant if the **Show Markers Across All Time-lines** item is cleared.

• **Show Line for Each Time-line** - This item draws a horizontal line in the middle of each time-line.
• **Zoom Out ..., Zoom In to Show Fewer Time-lines** - As previously discussed, this item shows more or fewer time-lines.

### D.2.3 Markers Window

The **Markers** window is the central location for information about markers. The image below shows the Markers window.

![Markers Window Image]

#### D.2.3.1 Function

The **Markers** window shows a quick overview of the important properties of the markers defined in the current project, and it provides easy access to all marker-related operations.

#### D.2.3.2 Features

A `>>` in the leftmost column indicates the currently selected marker. The columns in the Markers window show the following information about each marker:

- **Name** – Shows the name given to each marker.
- **Type** – Indicates the marker type, as listed in Table D-1 on page 72.
- **Count** – Shows the number of occurrences of this marker.
- **Key** – Indicates the keyboard key associated with the marker.
- **Show** – When selected, this item displays the occurrences of this marker in the **Activity** window, and also in the Video or Scalar windows as appropriate for the marker type.
- **Display Color** – Shows the color used to display occurrences of this marker in the Activity, Video, or Scalar windows. Click a marker in the **Display Color** column to open a color selection dialog box, which allows changing the display color for a marker.

#### D.2.3.3 Markers Right-click Menu

Right-clicking the mouse in the Markers window opens a right-click menu.
• **Define New Marker** - This item opens the Define New Marker dialog box.

![Define New Marker dialog box]

— **Type** - In the Type area, select a marker type for the new marker. For a description of all marker types, see Table D-1 on page 72. Under most circumstances, a new Frame marker cannot be created.

— **Name** - Enter a unique name for the new marker. Marker names must be unique.

— **Comment** - This is an optional box in which a free-form comment that describes the new marker may be typed.

— **Associated Keystroke** - This area identifies the keystroke that is associated with this marker, which can be used for finding or inserting new marker occurrences. CinePlex Editor suggests an unused key; click Change to open the Assign Key dialog box and select a different key. When the dialog box appears, press the key to associate and click OK.

**Note:** Only single-keystrokes (not CTRL- or ALT-key combinations) can be associated with Markers.

— **Display** - This area identifies the display color and the show setting for the marker.
– **Color** – This box shows the display color for this marker in various windows. You can also set the color directly in the Marker window.

– **Show** – This item toggles the appearance of the Marker in various windows. You can also set this item directly in the Marker window.

— **Event IDs** - This area shows the Event IDs associated with the marker. Use these IDs only when this marker is exported to a PLX file. These event IDs are the Plexon external event IDs that represent this marker in the PLX file. For interval-type markers, a second event ID must be specified to represent the end time for the interval.

**Note:** These IDs must be unique across all markers. CinePlex Editor suggests an unused and unique value for these IDs, so they do not usually require immediate attention when the marker is first created. If the data is exported to a PLX file, there will be an opportunity to change these event IDs.

**Note:** You can also click **Generate Occurrences** to have CinePlex Editor create the marker and also automatically populate the new marker with algorithmically-generated marker occurrences. The available methods for automatically populating the marker with marker occurrences varies by marker type; for a description, see “Automatically Generating Marker Occurrences” on page 106.

— **OK** - Click **OK** to close the dialog box and create the new marker.

• **Edit Selected Marker** - This item opens the **Edit Marker** dialog box.

![Edit Marker Dialog Box]

**Note:** You can also open the **Edit Marker** dialog box from the right-click menus in the Markers and Marker Occurrences windows.

The marker type cannot be changed for an existing marker. However, it is possible to change the following marker items:
— **Name** - Enter a unique marker name. Marker names *must* be unique. Duplicates are not accepted during the **Add Marker** process.

— **Comment** - Add, add to, or edit a free-form comment that describes the marker.

— **Associated Keystroke** - This area identifies the keystroke that is associated with this marker; click **Change** to open the **Assign Key** dialog box and select a different key. When the **Assign Key** dialog box appears, press the key to associate and click **OK**.

**Note:** Only single-keystrokes can be associated with markers. CTRL- or ALT- key combinations are not valid.

— **Display** - This area identifies the display color and the show setting for the marker.
  
  — **Color** – This box shows the display color of this marker in various windows. Select a new color from the drop-down list.
  
  — **Show** – This item toggles the appearance of the marker in various windows. Change as needed.

— **Event IDs** - This area shows the **Event IDs** associated with the marker. These event IDs are used when this marker is exported to a PLX file; for more information, see **Event IDs** on page **D-39**. Change the event IDs as needed.

• **Delete Selected Marker** - This item deletes the selected marker and all of its occurrences.

• **Delete All Highlighted Markers** - This item deletes all selected markers and all of their occurrences.

• **Delete All Occurrences of Selected Marker** - This item deletes all of the occurrences of the selected marker, but does not delete the selected marker.

• **Make Copy of Selected Marker** - This item copies the selected marker to the clipboard.

• **Set As Top Row** - Sets the highlighted items in the Show or Display Color columns to the same value or color as the topmost value.

• **Randomize Display Colors** - Sets random colors for all of the Display Color items.
D.2.4 Input Window

D.2.4.1 Function
The Input window consists of an area of option buttons (left side of window) and an array of marker buttons (right side of window). The option buttons control the operation occurring with keystrokes, the marker buttons, or the left mouse button.

D.2.4.2 Features
The Input window includes selections for the following three actions:

• **Keystroke** – You can bind a keystroke to the current marker, which can be used to Find the next occurrence of the marker or Insert a new occurrence of the marker.

  **Note:** If CinePlex Editor is in looping mode (see “Understanding Looping” on page 98), the search for the next marker occurrence wraps around the end of the file and continues the search at the beginning.

• **Button** – Specific marker buttons appear in the array on the right side of the Input window. Click a marker button to Find the next occurrence of the marker or Insert a new occurrence of the marker.

• **Left-Click** – This item refers to a click of the left mouse button in the Activity window. Select finds the nearest occurrence of the selected marker. Insert inserts a new occurrence of the selected marker at the time corresponding to the mouse pointer position when the left mouse button is clicked.

D.2.5 Channels Window

D.2.5.1 Function
The Channels window displays all of the channels in the neural data file and their associated properties.
D.2.5.2 Features
The columns in the Channels window list the following information for each channel:

- **Name** – Shows the name of the channel
- **Type** – Indicates the type of channel, either spike or continuous
- **Count** – Shows the number of spikes for spike channels, or the number of samples for continuous channels
- **Show** – When selected, shows the spikes or continuous data from that channel in the Activity window
- **Unsorted, Unit a, b, c, ...** – Indicates the number of spikes in the channels that are unsorted, or that belong to Unit a, Unit b, etc.

**Note:** By default, if the Show checkbox is clear, any continuous data channels in the neural data file do not appear in the Activity window.

D.2.5.3 Channels Right-click Menu
Clicking the right mouse button will open a right-click menu with the following items:

- **Show All Channels With Spikes** - Clicking this item resets the window to show all channels with spikes.
- **Un-Show All Channels** - Clicking this item resets the window to hide all channels.
- **Show Only Selected Channel** - Clicking this item resets the window to only show the selected channel.
- **Set As Top Row** - Clicking this item sets selected columns to the same value as the same columns in the top row.
D.2.6 File Info Window

The File Info window does not appear by default. To open the File Info window, from the View menu, select File Info View.

<table>
<thead>
<tr>
<th>CinePlex Project File</th>
<th>Video Data File</th>
<th>Neural Data File</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>File Name</strong>: C:\Program Files\CinePlex</td>
<td><strong>File Name</strong>: C:\Program Files\CinePlex</td>
<td><strong>File Name</strong>: C:\Program Files\CinePlex</td>
</tr>
<tr>
<td><strong>Comment</strong>:</td>
<td><strong>Time &amp; Date (from file)</strong>: Thursday, March 03, 2023</td>
<td><strong>Time &amp; Date (from file)</strong>: Thursday, March 03, 2023</td>
</tr>
<tr>
<td></td>
<td><strong>Frame Rate</strong>: 30.0000000</td>
<td><strong>Frame Rate</strong>: 1789</td>
</tr>
<tr>
<td></td>
<td><strong>Number of Frames</strong>: 1789</td>
<td><strong>Number of Frames</strong>: 1789</td>
</tr>
<tr>
<td></td>
<td><strong>Has Timestamps</strong>: Yes</td>
<td><strong>Has Timestamps</strong>: Yes</td>
</tr>
</tbody>
</table>

D.2.6.1 Function

The File Info window shows various items of information about the neural data files and video files that are currently loaded into CinePlex Editor.

D.2.6.2 Features

The File Info window contains the following items:

- **CinePlex Project File** - This area contains information about the currently opened CinePlex project file.
  - **File Name**: - This item contains the name of the project file.
  - **Comment**: - This editable item contains comments about the project file.

- **Video Data File** - This area contains information about the currently opened video data file.
  - **File Name**: - This item contains the name of the video data file.
  - **Time & Date (from file)**: - This item contains the time and date that the video data file was last modified.
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— **Video Size**: - This item contains the resolution of the video data file. Default is 640 X 480.

— **Frame Rate**: - This item contains the frame rate of the video data file. Default is 30 frames per second.

— **Number of Frames**: - This item contains the total number of frames in the video data file.

— **Has Timestamps**: - This item indicates if the frames are timestamped or not.

- **Neural Data File** - This area contains information about the currently opened neural data file.
  
  — **File Name**: - This item contains the name of the neural data file.
  
  — **Time & Date (from header)**: - This item contains the time and date that the neural data file was last modified.
  
  — **Comment**: - This item contains comments about the neural data file. This field is not editable in the File Info window.

  — **File Size (bytes)**: - This item contains the size of the neural data file in bytes.

  — **Experiment Length (sec)**: - This item contains the duration of the experiment in seconds.

  — **Format Version**: - this item contains the format version of the file.

  — **Channels**: - This item contains the total number of channels.

  — **Data Type**: - This item contains the data type. Values are **Single** or **Trodal**.

  — **Timestamp Frequency (Hz)**: - This item contains the frequency at which the timestamps are created. Default is 40,000 Hz.

  — **A/D Frequency (Hz)**: - This item contains the analog-to-digital frequency. Default is 40,000 Hz.

  — **Total Number of Waveforms**: - This item contains the total number of waveforms in the neural data file.

  — **Cont. Channels**: - This item contains the number of continuous channels.

  — **Peak Voltage (mV)**: - This item contains the peak voltage of the signals in millivolts.

  — **A/D Resolution (bits)**: - This item contains the analog-to-digital resolution in bits. Default is 12.

  — **Total Number of Units**: - This item contains the total number of occurrences for all channels.
— **Number of Channels with Units**: This item contains the number of channels that have units.

— **Avg Units per Active Chan**: This item contains the ratio of **Total Number of Units** to **Number of Channels with Units**.

### D.2.7 Audio Output Window

The Audio Output window is hidden by default. To open the Audio Output window, hover the mouse over the Audio tab of the sidebar tabs at the right side of the screen, select **Audio Output** from the **View** menu, or click the **Audio Output View** button on the toolbar. The image below shows the Audio Output window.

#### D.2.7.1 Function

The Audio Output window controls CinePlex Editor’s ability to play a sound through the computer’s audio system when Markers or neural spikes occur during data playback.

#### D.2.7.2 Features

The columns of the Audio Output window include:

- **Name** - This column contains the name of each marker.
- **Type** - This column contains the type of each marker.
- **Count** - This column contains the number of occurrences of each marker.
- **Play** - This column contains a checkbox that controls whether any sound will be played when the Markers or neural spikes of that type pass by the ‘current time’ marker during animated playback.
- **Sound** - This column contains a droplist that lists all the available sounds that CinePlex Editor can play. If the Play checkbox is checked, the sound selected in the Droplist will play when an occurrence of the corresponding Marker or neural spike is encountered during playback. The contents of this list can be controlled from the **Audio** tab of the **Tools | Options...** dialog, see “Options” on page D-58.
D.2.7.3 Audio Output Right-click Menu

The Audio Output Window has a right-click context menu that contains the following menu entries:

- **Show Units** - The Audio Output view can show just one line per neural spike channel (the default). In this mode, CinePlex Editor will play the same selected sound when any spike occurs on that channel, regardless of the unit designation of that spike. When Show Units is checked, each unit on each channel gets a separate line, as shown in the above screenshot. In this mode, every unit can have a different sound mapped to it and can be independently enabled or disabled for playing. This selection is equivalent to checking or unchecking the ‘Show Units in the Audio Output Window’ checkbox on the Tools | Options | Audio tab.

- **Select Sounds** - Clicking this item will show the Audio tab on the Tools | Options dialog box, which allows loading new sounds from WAV files so that they are available for mapping to Markers or Units.

D.2.8 Messages Window

To open the Messages window (hidden by default), hover the mouse over the Messages tab of the sidebar tabs at the right side of the screen, select Messages from the View menu, or click the Messages View button on the toolbar.

D.2.8.1 Function

The Messages window displays timestamps and application events and is used for troubleshooting purposes by Plexon Support.

D.2.8.2 Features

- **Time** - This column contains timestamps of the events.
- **Message** - This column contains descriptions of the events.

D.2.8.3 Messages Right-click Menu

Right-clicking the mouse in the Messages window displays the right-click menu.
• **Erase** - Clicking this item erases all messages from the Messages window.

• **Pause** - If this item is checked, message logging is paused.

• **Show Debug Messages** - If this item is checked, then debug messages will appear in the Messages window. This can be useful for troubleshooting.

• **Select and Copy All** - Clicking this item selects all the messages and copies them to the clipboard.

• **Save Log to File** - Clicking this item displays a standard file save dialog box and allows the message log to be saved to a file.

• **Mail Log to Plexon** - Clicking this item will sent the messages log to Plexon for troubleshooting. Note that a mail client and associated account information must be present on the computer for E-mail to work.

**D.2.9 Marker Occurrences Window**

The Marker Occurrences window includes an entry for each occurrence of the currently-selected marker. The currently-selected marker occurrence appears with a > in the first column. Click any marker to make it the currently-selected marker. More than one Marker Occurrences window may be opened. The window also changes title and columns depending on the marker type of the currently-selected marker.

**D.2.9.1 Function**

The function of the Marker Occurrences window is to display information about all occurrences of the currently selected marker.

**D.2.9.2 Features**

The features of the Marker Occurrences window will vary according to the type of selected marker. A coordinate marker will have the timestamp, an x-coordinate, and a y-coordinate while an interval marker will have the beginning timestamp and the ending timestamp as shown in the images below.
Scrolling the Activity window or animate time causes the Marker Occurrences window to update continually to show the marker occurrences closest to the current time.

**D.2.9.3 Marker Occurrences Right-click Menu**

Right-clicking the mouse in the Marker Occurrences window opens a right-click menu.

- **Go to Selected Marker Occurrence Time** - Clicking this item makes the time of the currently-selected marker occurrence the current time. This will advance the current frame and reposition the Activity window.

- **Add, Edit, and Delete Marker Occurrence Menu Items** - The items in the section below ‘Go to Selected Marker Occurrence Time’ except for “Delete Highlighted Marker Occurrences” are the same as the items on the **Edit** menu. For complete information, see “Edit Menu” on page D-38.

There are three different ways to display marker occurrence data:

- **Show Values in Decimal** - Clicking this item displays the marker occurrence data in normal decimal format.

- **Show Values in Hex** - Clicking this item displays the marker occurrence data in hexadecimal format.

- **Show Values as VT Bit Fields** - Clicking this item displays the marker occurrence data as VideoTracker (VT) bit fields. For more information on VT
bit fields, see “Marker Occurrences and the Marker Occurrences Window” on page D-73.

- **Copy and Select All** - These items function as standard Windows® copy and select functions.

- **Properties** - Clicking this item displays the **Marker Occurrences View Properties** dialog box. Clicking this item enables the configuration of marker occurrence windows to show the marker occurrences of a specific marker instead of the currently selected marker. This capability may be used to display marker occurrences simultaneously for different markers on screen.

  — **Marker To Display** - This area contains a drop-down list of markers. The currently selected marker appears in the dimmed list box.

  — **Display Format for Scalar Marker Values** - This area contains items that control the display format for Scalar markers:
    - **Decimal** – This item displays the Scalar markers in decimal format.
    - **Hex** – This item displays the Scalar markers in hexadecimal format.
    - **VideoTracker** – This item displays the Scalar markers in Plexon VideoTracker format.

**D.2.10 Scalar Window**

**Scalar** windows do not appear by default in CinePlex Editor. To open a Scalar window, from the **View** menu, select **New Scalar View**.

**D.2.10.1 Function**

The **Scalar** window provides an at-a-glance graphical representation of a scalar value as a pointer arrow on a scale.
D.2.10.2 Features
The Scalar window re-orients itself depending on the size of the view. If the Scalar window is tall and narrow, the pointer points horizontally. If the Scalar window is short and wide, the pointer points vertically. Like the coordinate crosshairs in the Video window, the position of the pointer always reflects the value for the selected marker occurrence. The numerical value also appears next to the pointer. Like the Marker Occurrences window, there can be multiple Scalar windows on the screen at once, with each one showing a different scalar marker.

D.2.10.3 Scalar Right-click Menu
Right-clicking in the Scalar window displays the following menu:

- **Reverse Arrow Direction** - By default, the Scalar window re-orients itself depending on its size. If the Scalar window is tall and narrow, the arrow is horizontal. If the Scalar window is short and wide, the arrow is vertical. By default, the arrow points either left or up, but the direction may be reversed by selecting **Reverse Arrow Direction** from the right-click menu. The position of the arrow always reflects the value for the selected marker occurrence. As shown in the following image, the numerical value of the selected scalar marker occurrence also appears at the base of the arrow.

Like the Marker Occurrences window, there can be multiple Scalar windows on screen at once, with each one showing a different Scalar marker.

- **Reset Automatic Range Adjustment** - By default, CinePlex Editor automatically adjusts the range of scalar values to accommodate the range of scalar values that appear in the data as new Scalar values become current. You can reset the range by selecting **Reset Automatic Range Adjustment** from the right-click menu, which sets the range to dynamically expand based on the subsequent values that appear. Alternately, a fixed range may be set in the **Scalar View Properties** dialog box.

- **Properties** - Clicking the **Properties** item displays the **Scalar View Properties** dialog box.
— **Marker To Display** - This area contains the items that control which marker appears in the Scalar window:

  - **Use Selected Marker** – This item displays the current value for a new marker in the Scalar window, if the marker is a Scalar type.

  - **List box** – Clearing **Use Selected Marker** causes the Scalar window to display the values of the Scalar marker that appears in the drop-down list, regardless of which marker is selected.

— **Layout** - The area contains the items that control the appearance of the Scalar window:

  - **Automatic** – This item sets the Scalar window to automatically switch its layout from horizontal to vertical based on the current size of the Scalar window. For example, if the window is taller than it is wide, a vertical layout appears, otherwise a horizontal layout appears.

  - **Horizontal** – This item sets the Scalar window to a horizontal layout, regardless of the dimensions of the Scalar window.

  - **Vertical** – This item sets the Scalar window to a vertical layout, regardless of the dimensions of the Scalar window.

  - **Reverse Arrow Direction** – This item toggles the direction that the indicator arrow points between up/down for horizontal layouts and left/right for vertical layouts.

— **Range to Plot** - This area contains the minimum and maximum values to show on the scale:

  - **Automatically Set Range from the Data** – This item automatically and dynamically adjusts the range as new values are encountered in the Scalar marker occurrences. The current range being plotted always appear dimmed in the **Minimum** and **Maximum** boxes.
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- **Fixed Range** – This item allows entering specific values for the range in the Minimum and Maximum boxes.

D.3 Menus

Menus provide access to CinePlex Editor features, commands, controls, and settings. The following sections describe each CinePlex Editor menu in detail. You can also use the toolbar buttons to execute many of the commands that appear on the CinePlex Editor menus.

![File menu](image)

**D.3.1 File Menu**

The following image shows the File menu.

**D.3.1.1 New Project**

This item opens the New Project Wizard dialog box which proceeds through the necessary steps to set up a new project. In the Welcome To CinePlex dialog box, click Start a New CinePlex Project to open the New Project Wizard dialog box. Otherwise, from the File menu, click New Project.
The first box in the **New Project Wizard** dialog box helps to select filenames.

**Note:** Specify a video file or a neural data file, or both.

- **Video Data Input File (AVI)** - This box allows you to specify a filename for the video file. The video file must be an Audio Video Interleave (AVI) file.

- **Neural Data Input File (PLX, NEX, DVT)** - This box allows you to specify a file name for the neural data file. The neural data file can be a Plexon data (PLX) file, a NeuroExplorer® NEX file, or a digital video tracker (DVT) file.

- **CinePlex Project File (CPJ)** - This box requires you to specify a filename for the CinePlex Project (CPJ) file.

- **Browse** - This button allows you to open a file selection dialog box. When one filename is selected, CinePlex Editor suggests names for the remaining unspecified filenames, which are based on the selected filename.

- **Select From Directories** - This button opens the **Select Video and Neural Data Files** dialog box, which provides a convenient alternative to **Browse**, where it is possible to display and match pairs of files from two directories. The **Select Video and Neural Data Files** dialog box provides list boxes for two different directories. You can use the various features of this dialog box to create project files.
### Video Data Input File (AVI)
- This area displays AVI files, file system dates, and times. Click the ... button to select a different directory for the video data files.

### Neural Data Input File (PLX, NEX, DVT)
- This area displays PLX, NEX, and DVT files, file system dates, and times. Click the ... button to select a different directory for the neural data files.

### Sort Files by Date
- This checkbox is checked by default and causes the files to be sorted by date. Click to clear this checkbox to sort by file name.

### Sync Directories
- If this checkbox is checked, it forces the two directories to be identical, which can save the effort of having to reselect the same directory again if the video and neural data files happen to reside in the same directory.

### Neural Data Extensions
- These checkboxes allow you to select the extensions for the neural data files to appear in the list box.

Whenever a file is selected from one of the list boxes, the dialog box attempts to select the file from the other list box that best matches the file selected. This feature is very convenient for matching up the files collected using CinePlex Studio with their corresponding PLX files, because the file dates and times should be nearly the same.

When the correct files have been highlighted in the two directory listings, click **OK** to enter the selected files into the appropriate text boxes in the **New Project Wizard** dialog box. After entering the correct filenames, click **Continue >>** to open the **Verify Project Files** dialog box.
The **Verify Project Files** dialog box provides complete information on the files being entered into the project. It lists relevant information for each file type.

- **CinePlex Project File** - This box lists the project file location and name.
- **Video Data File** - This box lists the video file location and name.
- **Time & Date (from file)** - This box shows the date and time (hh:mm:ss) when the video file was saved.
- **Duration** - This box indicates the duration of the video file in seconds.
- **Number of Frames** - This box lists the total number of frames in the video file.
- **Frame Rate** - This box indicates the frame rate at which the video was recorded.
- **Resolution** - This box shows the resolution of the video in pixels.
- **Has Timestamps** - This box indicates **Yes** if timestamps are contained in the video file and **No** if otherwise.
- **Format** - This box shows the video compression format of the file.
- **Neural Data File** - This box lists the neural file location and name.
- **Date/Time** - This box shows the date and time (hh:mm:ss) when the neural file was saved.
- **Duration** - This box indicates the duration of the neural file in seconds.
- **Channels** - This box lists the number of data channels in the neural file.
- **Event Types** - This box lists the number of different event types contained in the neural file.
After verifying that the correct files have been selected, click **Continue >>** to exit the Wizard. **CinePlex Editor** creates the initial project file.

**Note:** To have the directories containing the files selected appear as the defaults the next time CinePlex Editor starts, from the **Tools** menu, choose **Options**, click the **General** tab, and select **Use the last directory of the previous session as Initial Directory**.

**Note:** Keep the related project (CPJ), neural data (PLX) and video (AVI/DVT) files together in the same folder. Then, after you open the CPJ file, the system will automatically find the appropriate PLX and AVI/DVT files.

**D.3.1.2 Open Project**

This item opens a standard Windows **Open** dialog box to allow choosing an existing project file (CPJ) to open.

**D.3.1.3 Save Project, Save Project As, and Close Project**

These items apply to a CPJ file and its related video file and neural data file. These commands use standard Windows dialog boxes.

**D.3.1.4 Import Markers**

This item opens a standard Windows **Open** file-selection dialog box. When a file is selected, CinePlex Editor imports the file to create new markers in the project; for more information, see “Importing Markers” on page 115.

**D.3.1.5 Export Markers**

This item opens the **Export Marker Data** dialog box. The **Export Marker Data** dialog box includes all the items to set prior to exporting the file. The following image shows the default view of the dialog box.
• **Format** - This area provides a choice of two file types: Text file or comma-separated-values (CSV) file.

• **Delimiter to use between values** - This dropdown allows you to select one of the following delimiters to use between the columns of text (if Text File is selected for the format):
  — Comma
  — Comma, space
  — Space
  — Semicolon
  — Tab

• **Export a Row of Column Headers** - This checkbox allows exporting the first row as a row of textual labels for each column, which can be helpful when you are reading the exported data file.

**Note**: CinePlex Editor exports marker occurrences for all formats as one occurrence per row, and all rows have the same number of entries. The number of entries in each row depend on the selections made in the What to Export for Each Marker Occurrence area.

• **Which Markers** - The default value is Selected Marker only. Selecting All Markers causes the occurrences for all markers to be exported.
• **What to Export for Each Marker Occurrence** - The selections in this area determine which columns appear for each marker occurrence (row). The available columns always appear in a fixed order; clearing a checkbox removes the column. The available items for export are:

  — **Marker Name** – This item includes the textual name of the marker in the exported file. The marker name is generally useful only when selecting *All Markers* to export; otherwise, the marker name is the same for all marker occurrences when selecting *Selected Marker only* to export.

  — **Marker Type (Number 1-7)** – This item exports a number that indicates the type of the marker, as indicated in the following table:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time-only</td>
</tr>
<tr>
<td>2</td>
<td>Frame</td>
</tr>
<tr>
<td>3</td>
<td>Interval</td>
</tr>
<tr>
<td>4</td>
<td>Scalar</td>
</tr>
<tr>
<td>5</td>
<td>Coordinates</td>
</tr>
<tr>
<td>6</td>
<td>Level Interval</td>
</tr>
<tr>
<td>7</td>
<td>Zone Interval</td>
</tr>
</tbody>
</table>

  **Note**: For a complete explanation of the marker types, see “Understanding Markers and Marker Occurrences” on page 72.

  — **Marker Event ID** – This item exports the Event ID associated with this marker; for more information, see *Event IDs* on page D-39.

  — **Marker Event ID 2** - This item exports the second Event ID associated with this marker. This item applies only if the marker is an Interval, Level Interval, or Zone Interval type.

  — **TimeStamp** - This item exports the time of the marker occurrence. For Interval-type events, this is the start time.

  **Note**: You can export timestamps in units of seconds or in raw clock ticks; see “Export TimeStamps in units of”, which follows in this list.

  — **TimeStamp2 (End Time for Intervals)** - This item is only relevant for Interval-type marker occurrences and it exports the end time.

  — **Value 1 (Scalar value, or X Coordinate)** - This item exports different things, which depend on the marker type. For Scalar markers, it exports the scalar value. For Coordinate markers, it exports the X coordinate value. For all other markers, it exports -1.
— **Value 2 (Y Coordinate)** - This item exports different things, which depend on the marker type. For Coordinate markers, it exports the T coordinate value. For all other markers, it exports -1.

— **Export TimeStamps in units of** – You can export time stamps in one of the following units:
  - **Seconds** – This item exports the values for **TimeStamp** and **TimeStamp 2** in seconds.
  - **Clock Ticks** – This item exports the values for **TimeStamp** and **TimeStamp 2** in raw ticks of the system clock.

- **Output File** - Type or select the output file name in the **File** box. Under **Format**, click the **Append if existing** checkbox to append the marker data onto the end of a file that already exists on disk. Otherwise, the existing file is overwritten.

---

**CAUTION**

**Set the Append if existing checkbox correctly**

Pay special attention to the **Append if existing** checkbox. If it is **checked**, the new marker data will be appended to the existing file. If it is **unchecked**, the new export file will overwrite the current export file.
D.3.1.6 Export to PLX

This item opens the Export To PLX dialog box.

- **File** - Type an export file name and path, or click **Browse** and select an existing file.

- **Export invalidated spikes** - Click this checkbox to export invalidated spikes to the PLX file. Invalidated spikes appear with a unit number of 0 (unsorted).

- **Marker Mapping to Event IDs** - This list box controls which markers appear in the output file and which event IDs represent them. Only Time-only, Frame, and Interval-type markers appear in this list box; Scalar and Coordinates markers must be represented by strobed events. To remove individual markers from the output PLX file, click to clear the **Write?** checkbox. You can also change the event IDs by typing a new value in the **Event ID** column. There are two entries in the list box for each Interval-type marker, one for the start time and another for the end time.

- **What to Export as Strobed Events** - Select one of these items to export:
  
  — **Original Strobed Events (Passthrough Mode)** – Select this item to pass unchanged the strobed event data blocks from the original neural data file through to the output PLX file. Use this mode when if not interested in representing any changes to any Scalar or Coordinates marker occurrences in the output file, or if there are not any Scalar or Coordinates data to output.
Scalar Marker – Select this item to represent the values from a single Scalar marker in the strobed events. Select the Scalar marker from the list.

Coordinate Markers – Select one of the following combinations:
- Click LED 1, LED 2, or LED 3 or any combination of these LEDs. For each LED, select a corresponding Coordinates marker from the drop-down list.
- To export coordinates for the centroid position, click Centroid Pos and select a corresponding Coordinates marker from the drop-down list.
- To include Motion Measure data, click Centroid Pos and click a corresponding Coordinates marker from the drop-down list; then click Motion and select a corresponding Scalar marker from the drop-down list. For more information on the Motion Measure option, see “Motion Measure Option” on page 175.

Note: Select only one of the preceding combinations. If an LED is clicked, do not click Centroid Pos. Likewise, do not click Motion without clicking Centroid Pos.

D.3.1.7 Export to NEX
This item opens the Export To NEX dialog box.

- File - Type an export file name and path, or click Browse and select an existing file.
- What to Export - This area includes the following items:
  - Frame Markers – CinePlex Editor exports frame markers to the NEX file as just another marker variable. To inhibit this, click to clear the Frame Markers checkbox.
  - Unsorted spike timestamps – CinePlex Editor exports both sorted and unsorted spike timestamps to the NEX file by default. To export only
D CinePlex Editor User Interface

the sorted spike timestamps, click to clear the **Unsorted spike timestamps** checkbox.

— **Continuous data channels** – By default, CinePlex Editor exports any continuous channels present in the original neural data file as continuous variables to the NEX file. To prevent continuous data being written to the NEX file, click to clear the **Continuous data channels** checkbox.

• **Export!** - Click **Export!** to close the dialog box and create a new NEX file.

D.3.1.8 Print, Print Preview, and Print Setup

These items are standard Windows print commands. The **Print** command will output the CPJ file to an installed printing device.

D.3.1.9 File list

This section includes up to 10 of the most recently opened files.

D.3.1.10 Exit

This item closes all windows and exits CinePlex Editor.

D.3.2 Edit Menu

The following image shows the **Edit** menu.

![Edit Menu](image)

D.3.2.1 Undo

This item provides multiple undo levels. Operations that change the contents of the project file may be undone, but operations that change the user interface options or colors cannot be undone.

D.3.2.2 Copy

This item is the standard Windows copy command.
D.3.2.3 Define New Marker

This item opens the Define New Marker dialog box.

- **Type** - In the Type area, select a marker type for the new marker. For a description of all marker types, see Table D-1 on page 72. Under most circumstances, a new Frame marker cannot be created.

- **Name** - Enter a unique name for the new marker. Marker names must be unique.

- **Comment** - This is an optional box in which to insert a free-form comment that describes the new marker.

- **Associated Keystroke** - This area identifies the keystroke that is associated with this marker, which can be used for finding or inserting new marker occurrences. CinePlex Editor automatically suggests an unused key; click Change to open the Assign Key dialog box and select a different key. When the dialog box appears, press the key to associate and click OK.

  **Note:** Only single-keystrokes (not CTRL- or ALT- key combinations) can be associated with Markers.

- **Display** - This area identifies the display color and the show setting for the marker.
  
  — **Color** – This box shows the display color this marker in various windows. The color can also be set directly in the Marker window.
  
  — **Show** – This item toggles the appearance of the Marker in various windows. This item can also be set directly in the Marker window.

- **Event IDs** - This area shows the Event IDs associated with the marker. Use these IDs only when exporting this marker to a PLX file. These event IDs are
the Plexon external event IDs that represent this marker in the PLX file. For interval-type markers, a second event ID must be specified to represent the end time for the interval.

**Note:** These IDs must be unique across all markers. CinePlex Editor suggests an unused and unique value for these IDs, so they do not usually require immediate attention when first creating the marker. If exporting the data to a PLX file, there will be an opportunity to change these event IDs.

Clicking **Generate Occurrences** causes CinePlex Editor to create the marker and also automatically populate the new marker with algorithmically-generated marker occurrences. The available methods for automatically populating the marker with marker occurrences varies by marker type; for a description, see “Automatically Generating Marker Occurrences” on page 106.

- **OK** - Click OK to close the dialog box and create the new marker.

### D.3.2.4 Edit Selected Marker

This item opens the **Edit Marker** dialog box. An image of the dialog box follows:

![Image of the Edit Marker dialog box]

**Note:** The **Edit Marker** dialog box may also be opened from the right-click menus in the **Markers** and **Marker Occurrences** windows.

The marker type for an existing marker cannot be changed. However, it is possible to change the following marker items:

- **Name** - Enter a unique marker name. Marker names **must** be unique. Duplicates are not accepted during the **Add Marker** process.
• **Comment** - Add, add to, or edit a free-form comment that describes the marker.

• **Associated Keystroke** - This area identifies the keystroke that is associated with this marker; click **Change** to open the **Assign Key** dialog box and select a different key. When the **Assign Key** dialog box appears, press the key to associate and click **OK**.

**Note:** Only single-keystrokes can be associated with markers. **CTRL**- or **ALT**- key combinations are not valid.

• **Display** - This area identifies the display color and the show setting for the marker.
  
  — **Color** – This box shows the display color of this marker in various windows. Select a new color from the drop-down list.
  
  — **Show** – This item toggles the appearance of the marker in various windows. Change as needed.

• **Event IDs** - This area shows the **Event IDs** associated with the marker. These event IDs are used when exporting this marker to a PLX file; for more information, see **Event IDs** on page D-39. Change the event IDs as needed.

**D.3.2.5 Delete Selected Marker**

This item deletes the selected marker and all occurrences of that marker.

**D.3.2.6 Copy Selected Marker**

This item copies the selected marker to the clipboard.

**D.3.2.7 Add New Marker Occurrence**

This item opens the New Marker Occurrence window.

![New Marker Occurrence Window](image)

**Note:** **CinePlex Editor** identifies marker occurrences by their time, thus no two marker occurrences can have the same time. Adding a new marker occurrence with the same timestamp as an existing marker occurrence replaces the existing marker occurrence with the new one; that is, it is overwritten and the old data values are erased. Editing an existing marker occurrence by changing its timestamp to be the same as another existing marker occurrence replaces the existing marker occurrence.
**D.3.2.8 Edit Selected Marker Occurrence**

This item opens the Edit Marker Occurrence dialog box.

- **Marker** - This box shows the marker whose occurrence is being edited.
- **Time** - This is time of the marker occurrence and its related data values. The data values depend on the marker type. For example, for Interval markers, the start **Time** and **End Time** appear as shown in the image, but for Coordinates markers, X and Y data values appear.

**D.3.2.9 Delete Selected Marker Occurrence**

This item deletes only the selected occurrence for the marker.

**D.3.2.10 Delete All Marker Occurrences**

This item deletes all occurrences for the selected marker, but leaves the marker itself intact.

**D.3.2.11 Keystroke ..., Button Press ..., and Left-Click Inserts Marker**

These items determine which user action inserts markers. For information on marker insertion, see “Understanding Markers and Marker Occurrences” on page D-72.
D.3.3 View Menu

The following image shows the View menu.

All the items in this menu open or close a window in CinePlex Editor.

D.3.4 Animate Menu

The following image shows the Animate menu.

D.3.4.1 Play

This button automatically advances time at a rate determined by the time multiplier. Selecting Play when already playing causes a Pause condition.

D.3.4.2 Pause

This button halts the automatic advance of time. Play and Pause are mutually exclusive. Press SPACEBAR to toggle between Play and Pause. Selecting Pause when already paused resumes play.
**D.3.4.3 Slower**

If pressed while playing at any speed, this button slows down the rate of time progression by half until the speed is 1/256 of normal. Continued pressing reverses the direction and increases the speed.

**D.3.4.4 Faster**

This button speeds up the rate of time progression by a factor of 2. The **UP ARROW** key and the **DOWN ARROW** key are equivalent to the **Slower** and **Faster** buttons. Continued clicking will eventually cause the speed to reach a maximum of 256 times normal.

**D.3.4.5 Reset to 1X Speed**

This button sets the rate of time progression to 1X normal speed.

**D.3.4.6 Step Backwards**

This button advances time to the previous video frame. The **LEFT ARROW** key is equivalent to this button.

**D.3.4.7 Step Forward**

This button advances time to the next video frame. The **RIGHT-ARROW** key is equivalent to this button.

**D.3.4.8 Rewind**

This button sets the current time to the time of the first video frame.

**D.3.4.9 Reverse**

This button reverses the flow of time at the current time rate. If already in reverse, it goes forward.

**D.3.4.10 Lock to Video Frames**

This button advances time by increments of whole frames only. CinePlex Editor does not change the current time at all until enough time has elapsed to make a new video frame the current frame. Then it sets the current time to be the exact time of the frame marker corresponding to that frame. This is the default mode.

**Note:** A potentially confusing effect occurs when CinePlex Editor is in Frame Locking mode. If the video capture was paused during acquisition so that there is a gap of time that contains no frame marker occurrences, animation appears to freeze at the point where the gap starts until enough time passes such that the next video frame is current, which can be much later. Conversely, when CinePlex Editor is not in Frame Locking mode, the animation continues smoothly through the gap and time advances without regard to video frame boundaries. The video frame remains unchanged until the next one is encountered.

**D.3.5 Looping Menu**

The following image shows the **Looping** menu.
D.3.5.1 Toggle Looping

This item turns looping on or off for the interval selected in the list. Select this option to turn looping on during play back when a specific interval appears that should be reviewed. Playback loops from the beginning to the end of the interval. Click again to resume normal playback.

D.3.5.2 Select Looping Interval

This item opens the Looping Interval dialog box to allow a looping interval to be defined. An image of the dialog box follows:

- **Loop over entire file** - This is the default selection. CinePlex Editor plays the file to the end and restarts from the beginning.

- **Loop over an Interval Marker Occurrence** - This selection makes CinePlex Editor loop over the time span defined by a specified occurrence of an interval marker. When selecting this option, choose the interval marker from the drop-down list and then choose the specific occurrence of the interval marker to loop over.

  — **Nearest Occurrence** – uses the occurrence nearest to the current time
  
  — **Use Selected Occurrence** – uses the specific occurrence selected from the drop-down list

- **Loop over an arbitrary time interval** - This selection makes CinePlex Editor loop over an arbitrary interval of time specified in the Start and End boxes. Use the Looping toolbar controls to control looping parameters; see “Looping Toolbar” on page D-68.
D.3.6 Find Menu

The following image shows the Find menu.

![Find Menu Image]

D.3.6.1 Find Marker Occurrences

This item opens the Find Marker Occurrences dialog box to choose which marker to find. Either find the selected marker or choose from a dropdown list. An image of the dialog box follows:

![Find Marker Occurrences Image]

- **Use Selected Marker as Marker To Find** - By default, CinePlex Editor loads the current marker into the Marker To Find list box. To select another marker from the drop list, click to clear the checkbox and select another marker in the Marker To Find box.

- **Marker To Find** - Click to clear the Use Selected Marker as Marker To Find checkbox and select a marker from the drop-down list.

D.3.6.2 Find Forward

This item searches forward for the next selected marker.

D.3.6.3 Find Back

This item searches backward for the next selected marker.
D.3.7 Tools Menu

The following image shows the Tools menu.

D.3.7.1 Freezing Detector Function

See “Using the Freezing Detector” on page 119 for details about this function.

D.3.7.2 Levels Editor

This item opens the Levels Editor window. Use the Levels Editor dialog box to define level interval markers and generate marker occurrences for them. An image of the dialog box follows:
### CinePlex Editor User Interface

- **Scalar Marker To Use** - This box contains the scalar marker to use for generating levels.

- **Generate All** - This button generates marker occurrences for all the Level Interval markers that appear in the **Level Intervals** box.

- **Generate Selected** - This button generates marker occurrences for the selected level interval, which appears with a `>>` in the left-most column in the **Level Intervals** box.

**Note:** Clicking either **Generate All** or **Generate Selected** deletes all existing marker occurrences for the affected Level Interval markers, and generates a new set of occurrences according to the current Scalar marker and conditions.

The graph in the middle of the **Levels Editor** window shows the values of the selected Scalar marker as a function of time. The horizontal range of time that appears is always the entire file. The vertical scaling of the plot always adjusts to show the full range of the scalar data values. The levels appear as horizontal lines on the display, with the above or below setting for each level shown as either upward- or downward-pointing arrows on the lines. The number on the left indicates whether the line represents **Level 1** or **Level 2**.

**Note:** Positioning the mouse pointer inside this portion of the editor causes the scalar value corresponding to the pointer position to appear in the edit box at the bottom right of the display.

- **Level Intervals** - This area contains a grid that has a line for each defined level interval. Select level intervals by clicking in the grid. Set the condition by editing the grid fields. When defining multiple Level Interval markers, only the one selected in the **Level Intervals** box displays. Click any level interval to select it. The selected level interval appears with a `>>` in the leftmost column of the grid. The columns shown in the grid are:

<table>
<thead>
<tr>
<th>Level Interval Marker</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abv/Blw</td>
<td>This column contains the above or below indicator for the first level. To change the condition, click in this field to open a drop-down list and select <strong>Above</strong> or <strong>Below</strong>.</td>
</tr>
<tr>
<td>Level 1</td>
<td>This column contains the numerical value for the first level. Type a numerical value in this field or click and drag horizontal line 1 on the graph.</td>
</tr>
<tr>
<td>Color</td>
<td>This column contains the color associated with the Level Interval marker. To change the color, click in this field to bring up a color selection dialog box.</td>
</tr>
<tr>
<td>Abv/Blw</td>
<td>This column contains the above or below indicator for the first level. To change the condition, click in this field to open a drop-down list and select <strong>Above</strong> or <strong>Below</strong>.</td>
</tr>
<tr>
<td>Level 1</td>
<td>This column contains the numerical value for the first level. Type a numerical value in this field or click and drag horizontal line 1 on the graph.</td>
</tr>
</tbody>
</table>
- **Oper** – This column contains the logical operator between the two halves of the condition. The available selections in the drop-down list are **AND**, **OR**, or **N/A**. Selecting **N/A** means that there is only one level in the condition; CinePlex Editor ignores the last two columns and a second line on the graph does not appear.

- **Abv/Blw** – This column contains the **Above** or **Below** indicator for the second level, which only applies if N/A is not selected.

- **Level 2** – This column contains the numerical value for the second level, which only applies if N/A is not selected. Type a numerical value in this field or click and drag horizontal line 2 on the graph.

- **Add** - This button opens the **Define New Marker** dialog box to add a new Level Interval marker.

- **Delete** - This button deletes the selected interval level.

- **Center Lev1 and Center Lev2** - By default, CinePlex Editor sets the level intervals to the middle of the display range shown in the graph, which it determines from the range of scalar values encountered for the selected Scalar marker. Click these buttons to re-position the corresponding level line to the center of the view again.

- **Done** - Click **Done** to close the editor. CinePlex Editor stores the conditions with the Level Interval marker and displays them when the **Levels Editor** re-opens.
D.3.7.3 Zones Editor

This item opens the Zones Editor window. An image of the dialog box follows:

- **Coordinates Marker To Use** - This box lists the Coordinates marker used to define the zone.

- **Generate All** - This button generates marker occurrences for all the level intervals that appear in the **Zone Intervals** box.

- **Generate Selected** - This button generates marker occurrences for the selected Level Interval marker, which is indicated by the >> in the left-most column in the **Level Intervals** box.

**Note:** Clicking either **Generate All** or **Generate Selected** deletes all existing marker occurrences for the affected Zone Interval markers, and generates a new set of occurrences according to the current Coordinates marker and conditions.

- **Zone Intervals** - This area lists all the defined Zone Interval markers.
  - The leftmost column lists the interval number; the selected Zone Interval marker appears with a >> in the leftmost column.
  - **Zone Interval Marker** – This column lists the names of the Zone Interval markers. Add or change names by typing in this field.
  - **Color** – This column shows the colors of the zone boundaries. To change a color, click the color to open a color selection dialog box.
  - **Add** – This button adds a coordinate to the selected zone.
  - **Delete** – This button deletes the selected Zone Interval marker.
- **Coordinates of the Selected Zone** - This area lists the coordinates of the currently selected Zone Interval marker. The zone of a Zone Interval marker consists of a list of 2D coordinates (X and Y) that define the closed contour. Define these contours by clicking on the screen image (see **Add** that follows), or by individually adding and typing in the coordinate values in the columns.

  - The leftmost column lists the coordinate number; the selected coordinate appears with a >> in the leftmost column.

  - **X** – This column contains the X coordinate distance from the lower left corner (zero distance).

  - **Y** – This column contains the Y coordinate distance from the lower left corner (zero distance).

  - **Clear** - This button completely clears all points from the current zone. Click **Add** to re-enter the zone.

  - **Add** - This button puts the Zones Editor into the click-to-add mode. The first left-click in the main window defines the first point in the contour, subsequent left-clicks continue to define the contour. A right-click ends the drawing and closes the contour.

  - **Edit** - This button enables the currently selected point to be re-positioned. After clicking **Edit**, move the mouse pointer to the desired location on the main window. The contour continually re-adjusts as the mouse pointer moves. Left-click to select the new position, or right-click to cancel the operation and revert to the previous position.

  - **Delete** - This button deletes the currently selected point from the zone contour. The contour re-adjusts automatically for the remaining points.

When the **Zones Editor** dialog box is opened, the main view shows the same video frame that CinePlex Editor displays. By default, the zone for the currently selected Zone Interval marker appears superimposed on the video frame.

- **Show Selected Zone** - This is the default setting. It shows the zone for the currently selected Zone Interval marker superimposed on the video frame.

- **Show All Zones** - Click this button to see all defined Zone Interval marker zones simultaneously.

- **Show Complete Tail** - Click this button to display a line connecting all the positions visited by the selected Coordinates marker. This can help to show what effect various placements of the zone boundaries can have when a zone is defined.

- **Show Grid every** - Click this button to superimpose a grid over the video image. Enter the grid spacing in the box.

- **Coordinates: X Y** - When the mouse pointer moves over the main window, the corresponding coordinates of the mouse pointer appear in the **X** and **Y** edit boxes.
- **Done** - Click **Done** when finished defining zone intervals.

### D.3.7.4 Interval Operations

This item opens the Interval Operations dialog box.

![Interval Operations dialog box](image)

- **Interval Marker to Use** - From the drop-down list, select a marker of the following type:
  - Interval
  - Level Interval
  - Zone Interval

- **Operation to Perform Using Interval Marker** - In this area, choose one of the following operations:
  - **Invalidate Waveforms that occur within the Intervals** – This selection invalidates all waveforms that occur within (inclusive) the interval marker. CinePlex Editor compares each waveform (spike time) in every channel against all occurrences of the interval marker to see if it falls within the start and end times. If it does, CinePlex Editor marks the waveform as invalid.
  - **Remove Occurrences within the Intervals, for Marker** – This selection removes the occurrences of the marker selected from the drop-list, from within the intervals. CinePlex Editor compares the times of the occurrences of this marker to the selected interval occurrences, and removes any occurrences that fall within (inclusive) of any interval.

**Note:** In both cases, CinePlex Editor considers exact matches of the spike timestamp to the interval occurrence start or end times to be within the interval. For example, if spike time $T_{spike}$ is inside the interval defined by $T_{start}$ and $T_{end}$, it means that the condition $(T_{spike} \geq T_{start})$ and $(T_{spike} \leq T_{end})$ is true.
Negate the selected operation – This selection changes either of the previous selections to an exclusive function. Selecting **Invalidate Waveforms that occur within the Intervals** invalidates all waveforms that do not fall between the start and end times (exclusive) of any interval marker occurrences. Selecting **Remove Occurrences within the Intervals, for Marker** removes all occurrences of the selected marker that do not occur within the times spanned (exclusive) by any interval marker occurrence. The text in the **Interval Operations** dialog changes as follows:

D.3.7.5 Shift Marker Occurrences

This item opens the **Shift Marker Occurrences** dialog box. An image of the dialog box follows:
Use this dialog box to add a constant offset, which can be negative, to all timestamps of a marker. It is useful for aligning neural data with the video data.

- **Marker** - Select a marker to shift from the drop-down list.
- **First Occurrence Time** - This is the time that the first occurrence of the marker appears.
- **Last Occurrence Time** - This is the time that the last occurrence of the marker appears.
- **Range** - This is the time span between the first and last occurrences.
- **Shift by _ secs** - This selection shifts the occurrences by a constant amount. Enter the amount of shift directly in the edit box.
- **Shift so that first Occurrence is at time _ secs** - This selection calculates the shift amount by determining how much the first occurrence of the selected marker must be shifted to make it equal to the specified time. CinePlex then applies this shift amount to all occurrences.
- **Shift so that the first Occurrence is at time of Marker** - This selection shifts the time to that of another marker occurrence. Select the shift-determining marker from the drop list.
- **Occurrence** - Enter which occurrence of the shift-determining marker to use by typing its 1-based index into the edit box.

### D.3.7.6 Snap-To Marker Occurrences

This item opens the **Snap-To Marker Occurrences** dialog box. An image of the dialog box follows:

![Snap-To Marker Occurrences dialog box](image)

The purpose of the “Snap-To” functionality is to shift the occurrences of one marker to match up in time with the occurrences of another marker. However,
Unlike the **Shift Marker Occurrences** functionality described on page D-53, the “Snap-To” functionality can shift each occurrence by a different amount.

- **Marker To Adjust** - From the drop-down list, select the marker occurrences to match up in time.

- **Snap-To Occurrences of Marker** - From the drop-down list, select the marker occurrence to match up to in time.

**Note:** Typically, the **Snap-To Occurrences of Marker** are Frame marker types, which means the **Marker To Adjust** aligns with the times of the video frames.

The CinePlex Editor algorithm finds the best match occurrence of the **Snap-To Occurrences of Marker** entry for every occurrence of the **Marker To Adjust** entry, and makes the **Marker To Adjust** occurrence time equal to the time of the best match occurrence. There are two ways that CinePlex Editor determines the best match occurrence of the “Snap-To” marker:

- **Snap-to Previous Occurrence** – This selection uses the occurrence that is just before the time of the occurrence being adjusted. The adjustment always reduces the time of the occurrence being adjusted.

- **Snap-to Closest Occurrence** – This selection uses the occurrence that is closest in time to the occurrence being adjusted. The adjustment can shift the occurrence being adjusted ahead or behind in time.

- **Snap interval start and end times independently** - Because interval-type markers consist of two times (a start time and an end time), they are treated differently and they are controlled by this checkbox. When this box is checked, CinePlex Editor snaps both the start and the end times to their respective best match occurrences. This can change the length of the interval. When the checkbox is cleared, CinePlex Editor uses the best match to the start time to shift the entire interval. In this case, the end time shifts by the same amount as is the start time, so the length of the interval remains constant.

### D.3.7.7 Interpolate Missing Occurrences

This item opens the **Interpolate Missing Occurrences** dialog box. An image of the dialog box follows:
D CinePlex Editor User Interface

• **Marker** - From the drop-down list, select the marker to interpolate.

• **Periodicity** - This box displays the periodicity results for the selected marker as follows:
  
  — **Tolerances for Gaps** – For the gap analysis, the average separation between markers is determined. If the time gap between any two adjacent marker occurrences is not within the Tolerance for Gaps value (i.e. between \((1 - \text{TFG})\) and \((1 + \text{TFG})\) times the average separation, it is marked as a gap.

  — **pairs** – the number of pairs of adjacent times

  — **avg** – the average time difference between pairs in seconds

  — **stddev** – the standard deviation around the average time difference

  — **min** – the smallest time difference encountered in seconds

  — **max** – the largest time difference encountered in seconds

  — **non-gap avg** – the average time difference in seconds when the discovered gaps are excluded from the calculation

• **Gap Sizes** - This box lists of the distribution of skipped occurrences (gaps); for example, **0 : nnn** indicates the number of number of pairs without a missing timestamp between them, **1 : nnn** indicates the number with one timestamp missing, **2 : nnn** indicates the number with two missing timestamps, and so on.
• **Timestamp Determination** - The area contains the following two selections:
  
  — **Assume Periodicity** – This selection assumes that the data is periodic and adds marker occurrences accordingly.
  
  — **Use Frame Marker Times** – This selection adds missing marker occurrences at the frame markers.

• **Value Interpolation** - The area contains the following two selections:

  — **Sample-and-hold the previous value** – This selection assigns a value (or coordinates) to the new marker occurrences added to fill a gap, which is the same as the value (or coordinates) of the last pre-gap marker occurrence.

  — **Linear Interpolation** – This selection assigns values to the new marker occurrences added to fill a gap that are calculated to fall on a line connecting the last pre-gap value (or coordinates) with the first post-gap value (or coordinates).

If the marker being interpolated is a scalar marker or a coordinates marker, the tool can calculate reasonable values to apply to the added marker occurrences by using one of two methods:

**Generate new Time-only Marker at times for added Occurrences**

• **Generate new Time-only Marker at times for added Occurrences** - This selection enables the tool to define and populate a new marker named Interpolated X, where X is the name of the marker being interpolated, and which has occurrences at the times where interpolated marker occurrences are added. In effect, this differentiates the occurrences of the selected marker that are generated via interpolation from those that are part of the original data.

**How the Interpolation Algorithm Works**

The interpolation tool is capable of calculating both the times at which new marker occurrences need to be added (that is, where the gaps appear), and for Scalar markers and Coordinates markers, what values need to be given to the added marker occurrences. Obviously, when finding the times where there are gaps, there is an implicit assumption of periodicity in the marker occurrences. This may or may not be the case with the marker occurrences for the selected marker, but the tool displays information that helps to determine the extent to which the periodicity assumption is valid.

When a marker is selected, the algorithm analyses the times of the occurrences for that marker, and displays the results in the two list boxes. The algorithm can
use or ignore the results of this analysis, depending on the following *Timestamp Determination* selections. The analysis proceeds as follows:

1. Consider each pair of adjacent times for the marker occurrences, and calculate the time difference between each pair. The number of pairs appears in the left list box.

2. Find the min, max, average, and standard deviation on the set of calculated time differences. Display this information in the *Periodicity* list box as $\text{avg} =$ for the average time difference, $\text{stddev} =$ for the standard deviation around the average time difference, $\text{min} =$ and $\text{max} =$ for the smallest and largest time differences encountered.

3. Assume that any difference between adjacent occurrences that is larger than 1.1 times the average time difference constitutes a *gap*, or a skipped occurrence. Using this definition of a *gap*, compute and display a histogram of the sizes of the gaps in the *Gap Sizes* list box. The $0$: line in this list box is to be interpreted as the number of timestamp pairs for which there were no *gaps* or missing timestamps between them. The next $1$: line is the number of timestamp pairs for which there was a gap of 1 missing timestamp between the pair, and so on.

4. By ignoring the gaps, compute a new average time difference between adjacent, $\text{gap} = 0$ timestamp pairs. Display this as *non-gap avg* = in the *Periodicity* list box. Whereas the $\text{avg} =$ value has factored in the gaps and thus produced a larger average time difference, the *non-gap avg* = has taken out the gaps, and so produces a smaller and in many cases more accurate estimate of the true periodicity. In effect, this is the periodicity that would be seen if it weren't for missing samples (gaps) in the occurrences.

**D.3.7.8 Mark All Waveforms As Valid**

This item re-validates any waveforms that were invalidated with the Interval Operations tool; see “*Interval Operations*” on page D-52.

**D.3.7.9 Options**

This item opens the *Options* dialog box with several tabs as described in the following sections.
D.3.7.9.1 General Tab.

- **Initial Directories for Data Files** - This area contains list boxes and controls for the initial project directories as follows:
  - **Initial Directory for Project (CPJ) Files** – Type a directory location and name or click Browse and select an existing directory.
  - **Initial Directory for Video Files** – Type a directory location and name or click Browse and select an existing directory.
  - **Initial Directory for Neural Data Files** – Type a directory location and name or click Browse and select an existing directory.
  - **Always use the same Initial Directories** – This selection sets the default initial directories to the directories entered.
  - **Use the last directory of the previous session as Initial Directory** – This item sets the default initial directories to the directories used for the last project.

**Note:** If you move the original neural data or video files to the same folder on which the CPJ file resides, CinePlex Editor will find them automatically when it reopens the project file. If you move the original neural data or video files to some other location on the hard drive, CinePlex Editor prompts to locate the files when it reopens the project file.

- **Project File-Save Behavior** - When a project file is saved, from the drop-down menu one may set one of the following default file-save behaviors:
Note: On this menu, filename-0n means CinePlex Editor defaults to the first unused filename and adds a numeric increment 0 (zero) n (digit). For example, Test-01, Test-02, Test-03, etc.

- **Number of Frames to Advance During Click-To-Add** - Type the number of frames to advance when adding or editing coordinates in the Video or Scalar windows. For more information on Click-To-Add, see “Understanding Click-To-Add Mode” on page 101.

- **Select Marker Occurrence For Current Time** - Select this item to have CinePlex Editor automatically select, in the Marker Occurrences window, the most appropriate marker occurrence for the current time.

### D.3.7.9.2 File Import Tab.

- **Reading Buffer Size** - This area contains an input box for the reading buffer size setting and an advisory estimate of the amount of space waveforms take.
  
  — **Reading Buffer Size for data files (MB)** – Type a size value for the reading buffer in megabytes (MB).

- **Continuous Data** - This area contains an input box for the size of the continuous-data channel buffer and a checkbox that disables the loading of continuous-data channels to PLX files.
— **Channel Buffer size for continuous data (MB)** – Type a size value for the channel buffer in megabytes (MB).

— **Disable loading continuous data channels for PLX files** – This selection inhibits the loading of continuous data channels to PLX files.

— **Default Timestamp Frequency (if not specified in loaded file)** – If the initial neural data file does not specify a timestamp frequency (for example, a DVT file), enter a default timestamp frequency in Hz.

**D.3.7.9.3 Latency Correction Tab.** For more details on latency correction, see “Correcting for Video Latency” on page D-76.

- **Automatically compensate for video latency by adjusting Frame and Position Markers** - this setting is checked by default. This setting compensates for the amount of time elapsed between the camera’s capture of the image to the computer’s timestamp of the video frame (the video latency). If there is data that was analyzed with previous versions of CinePlex Editor, there may be timestamp shifts and this setting could be unchecked for that data.
  
  — **Amount of time to shift Markers** - Type the amount of time to shift the markers in seconds. The number should always be positive because the number is subtracted from the timestamps.

- **Automatically snap Position Markers imported from PLX files to the previous Frame Marker** - this setting is checked by default. This setting is applied automatically only when data is initially imported from a PLX file.

  **Note:** When CinePlex is being used with Plexon’s MAP system, leaving the MAP on overnight could result in excessive latency - much greater than 30 milliseconds. If the MAP has been left on overnight, it is better to reset the MAP system.
D.3.7.9.4 Display Tab.

- **Update Animation Every ___ Milliseconds** - Type an animation update frequency in milliseconds. This is the screen update rate while the video and data files play are playing.

- **Initially show ‘Welcome To CinePlex’ dialog box** - This selection makes the Welcome to CinePlex dialog box appear at startup.

- **Initially disable empty Spike Channels** - This selection suppresses empty spike channels in the Activity window at startup.

- **Initially disable Continuous Channels** - This selection suppresses continuous channels in the Activity window at startup.
D.3.7.9.5 Audio Tab.

- **Available Sounds** - CinePlex Editor ships with a selection of four WAV files, and these sounds are available for playback in CinePlex Editor by default. However, any WAV file can be used, provided that CinePlex Editor knows where to find it on the hard drive. Before WAV file sounds can be mapped to Marker or spike occurrences in the Audio Output Window, they must be loaded into CinePlex Editor. The **Available Sounds** section lists the Sounds that are currently available for playback. Each sound has a Label that shows up in the droplist in the **Sounds** column of the Audio Output Window, and the full path to the WAV file that contains the sound.

- **Add** - Pressing Add... will show a file selection dialog followed by the Sound Selection dialog box which allows entering a Label used to represent that sound. Pressing the **Play Sound** button will play the sound, which is useful for previewing.

- **Edit** - Highlighting an existing sound in the list and pressing Edit... will show the Sound Selection dialog box and allow re-selecting the WAV file or changing the Label for a sound.
• **Remove** - Highlighting an existing sound in the list and pressing Remove will remove the sound.

• **Play Sound** - Highlighting an existing sound in the list and pressing Play Sound will immediately play the sound, allowing it to be previewed.

• **Reset to Defaults** - Pressing the Reset to Defaults button will reset the list to contain the four sound files that are shipped with CinePlex Editor.

**HINT**

**Minimizing number of sounds to play**

Computer audio hardware can only mix a certain number of sound streams together, so CinePlex Editor can only play about 10 sounds simultaneously. Sounds that overlap in time because they are played quickly one after the other count as simultaneous sounds. Therefore, it is quite easy for CinePlex Editor to overwhelm the audio subsystem by attempting to play too many sounds, as Markers or neural firings may occur at rates too fast for the audio system’s capabilities. When this happens, CinePlex Editor will play as many sounds as it can, but there may be gaps in the audio playback. To minimize this issue:

a) do not select many units or markers to be played at once. Even a single neural channel with a high firing rate can saturate the audio.

b) use WAV files that are as short as possible. In this regard the 'neuralclick.wav' file is ideal, as it can be played very quickly.

**D.3.7.9.6 Colors Tab.**

• **Display Elements** - This area contains the following color choices for the main display:
— **Background** – This is the background color of the Activity window.
— **Text** – This is the text color in the Activity and Video windows.
— **Grid and zero line** – This is the color of the grid and zero line in the Activity windows.
— **Selection** – This is the color of selected items in the Video and Activity windows.
— **Restore Colors to Defaults** – Click to restore the display elements to their default colors.

- **Units** - This area contains the color choices for each unit and unsorted waveforms.
  — **Unsorted** – This is the color for unsorted waveforms.
  — **Invalidated** - This is the color for invalidated waveforms.
  — **Unit a: ... Unit p** – These are the color selections for up to 16 units.
  — **Restore Colors to Defaults** – Click to restore the unit colors to their default colors.

**D.3.7.9.7 Printing Options Tab.**

The selections on the **Printing Options** tab are the same as those on the **Colors** tab. See “Colors Tab” on page D-64
D.3.8 Window Menu

For more details on the Window menu, see Window Menu, above.

D.3.9 Run Menu

D.3.9.1 PlexUtil
This item launches the PlexUtil application.

D.3.9.2 Offline Sorter
This item launches the Offline Sorter application.

D.3.9.3 NeuroExplorer
This item launches the NeuroExplorer application.

D.3.9.4 Explorer
This item opens Windows Explorer.

See also Run Menu, above. and “Run Menu Customization” on page E-21.

D.3.10 Help Menu

For more details on the Help menu, see “Help Menu” on page E-12.
D.4 Toolbars

CinePlex Editor includes toolbars that provide access to features, commands, controls, and settings. Most features and commands are available on the toolbars. It is also possible to create toolbars from most of the dropdown menus on the menu bar. Briefly rest the mouse pointer over a button to see the button name. Descriptions of the toolbars follow:

D.4.1 Standard Toolbar

This toolbar includes typical Windows controls for file New, Open, Save, Cut, Copy, Paste, Print, Help, Undo, and Options. Except for Options, these are typical Windows controls. For information on Options, see “Options” on page D-58.

D.4.2 Edit Toolbar

The Edit toolbar includes a series of buttons that manage markers and marker occurrences within CinePlex Editor. This toolbar has eight buttons that correspond to the marker and marker occurrences commands on the Edit menu; see “Edit Menu” on page D-38.

D.4.3 Views Toolbar

The Views toolbar includes a series of buttons that open the various windows within CinePlex Editor. Each window opens at its default size. This toolbar’s buttons are equivalent to the commands on the View menu; see “View Menu” on page D-43.

HINT

Missing Buttons on the Views Toolbar

If there are missing buttons on the toolbar, select Window | Customize | Toolbars, and select the line labeled View in the list box in the Toolbars tab. Do not uncheck the checkbox -- just select the line. Then press the Reset button.

D.4.4 Animate Toolbar

The most convenient way to control the flow of time in CinePlex Editor is to use the time-control toolbar buttons. The associated Animate menu entries or
keyboard shortcuts may also be used; see “Animate Menu” on page D-43. The Animation Speed list box is the only Animate toolbar control that has no equivalent command on the Animate menu.

- **Animation Speed** - This list box provides a choice of time progression rates, where 1X is the normal speed. It has no equivalent on the Animate menu.

### D.4.5 Looping Toolbar

The Looping toolbar includes a list of looping intervals over which the video file may be played, and two looping control buttons. The equivalent Looping menu entries or keyboard shortcuts may also be used; see “Looping Menu” on page D-44.

### D.4.6 Find Toolbar

The Find toolbar provides a drop down list that includes all markers. The equivalent Find menu entries or keyboard shortcuts may also be used; see “Find Menu” on page D-46.

By default, the currently selected marker appears in the list box. However, another marker may be selected from the drop down list.

### D.4.7 Tools Toolbar

The Tools toolbar includes two time-interval editors. One editor for a defined zone of the video window and one editor for level interval markers. The equivalent commands on the Tools menu may also be used; see “Tools Menu” on page D-47.
D.5 How CinePlex Editor Creates Initial Project Files

When a new CinePlex project is created, CinePlex Editor reads both the neural data file and the video data file, and it generates markers and marker occurrences based on the contents of the files. After the initial file reading, CinePlex Editor stores the generated markers and marker occurrences in the project (CPJ) file. When the project file is re-opened, CinePlex Editor reads the markers and marker occurrences from the project file, not from the original neural data or video files. In this way, one may add, edit, shift, or delete markers without regard for what is actually in the original neural or video data files. However, when an existing project file is re-opened, CinePlex Editor still reads the neural data file in order to obtain the spike timestamps and continuous data, and it still reads the video file to obtain video frame images.

D.5.1 Reading Video (AVI) Files

When CinePlex Editor reads the video (AVI) file, it looks for timestamps embedded in the data stored with each frame. CinePlex Studio imbeds these timestamps. If the embedded timestamps are present, CinePlex Editor creates a special Frame marker, and it generates a marker occurrence for each video frame. See “Non-Typical Initial File Creation” on page D-70 if there are no embedded timestamps.

CAUTION
Upgrade Notice

If the system has been upgraded to CinePlex Studio 2.0, CinePlex Editor should also be update. The upgraded CinePlex Editor will read AVI files created by CinePlex Studio 1.0, 1.1, 1.2, and 1.4. However, earlier versions will not be able to read AVI files produced in version 2.0

D.5.2 Reading Plexon (PLX) Files

When CinePlex Editor reads a Plexon (PLX) file during the initial project creation, depending on the contents of the PLX file, it can create and populate a number of different markers as follows:

- Non-strobed external events (type 4 data blocks) become Time-Only markers
- Strobed events become a single Scalar marker, with the scalar values set to the strobe values
- If strobed events are present, and CinePlex Editor identifies them to be in conformance with the Plexon VideoTracker protocol, then CinePlex Editor generates additional markers by interpreting the strobe codes as data produced by Plexon VideoTracker. Depending on the VideoTracker mode detected, CinePlex Editor creates the following markers:
  - One, two, or three Coordinates markers with names like Position n to denote the tracker positions, when VideoTracker is in LED, Color Markers or Extended Tracking of Color Markers modes.
— A Coordinates marker named *Centroid Position*, when VideoTracker is in Object Contour tracking mode.

— A Scalar marker named *Centroid Motion*, when the VideoTracker Motion Measure option is enabled.

**Note:** In Plexon VideoTracker protocol, if VideoTracker cannot locate the object being tracked it reports the positions for those frames as (0,0); for example, if a headstage cable occluded the LED for a frame VideoTracker reports that frame as "0,0". When CinePlex Editor translates strobed events into Coordinates marker occurrences, it automatically ignores any (0,0) coordinates, which leaves gaps where there is no position data. The Interpolate Missing Occurrences tool can fill these gaps, see “Interpolate Missing Occurrences” on page D-55.

**Note:** Important: Spike waveforms and timestamps and continuous data from a PLX file are not converted into markers.

### D.5.3 Reading NeuroExplorer NEX Files

When CinePlex Editor reads a NEX file during the initial project file creation, it ignores the spike timestamps and continuous data. CinePlex Editor converts other NEX variables into CinePlex markers as follows:

- Event variables become Time-Only markers, unless the event variable has the exact name *Frame Marker*, in which case it becomes a Frame marker.
- NEX interval variables become interval markers.
- NEX marker variables that have one associated value become Scalar markers.
- NEX marker variables that have two associated values become Coordinates markers.
- CinePlex Editor ignores NEX marker variables with more than two associated values, and NEX population vector variables.

### D.5.4 Reading Digital VideoTracker (DVT) Files

When CinePlex Editor reads a DVT file produced by CinePlex Studio during the initial project file creation, it always creates Frame marker occurrences. CinePlex Editor also produces Coordinates and Scalar markers for the coordinate and centroid motion data streams in the file, in a manner analogous to how it translates the strobed values into markers in a PLX file.

After creating the initial project, one may import additional markers from additional data files into the project; see **Import Markers** on page D-32. The import operation also follows the preceding rules.

### D.5.5 Non-Typical Initial File Creation

The normal operating mode for CinePlex Editor is to use an AVI file captured with CinePlex Studio so that frame timestamps are embedded in the AVI file.
then load a neural data file that contains neural firing timestamps. However, other modes of operation may be used:

- When using the New Project Wizard, leave either the video-file filename or the neural-data filename blank, but not both. In effect, this allows CinePlex Editor to be used to annotate video data without the presence of neural data, and vice versa.

- If the video data file is blank, the CinePlex Editor Activity window may still be used. If the neural data file contains VideoTracker coordinates that are based the Plexon VideoTracker protocol, CinePlex Editor still interprets them as Coordinates marker occurrences and displays them against a blank background in the video window. However, it requires an extra step in this case to generate Frame markers artificially. The New Project Wizard detects when this needs to be done, and it automatically prompts.

- If the neural data filename is blank, CinePlex Editor still functions; the video can be viewed in the normal way: advance frame by frame, animate, etc.

**Note:** In both of the previous cases, new markers can still be entered and defined. It is still possible to export the markers to any of the supported output-file formats.

- CinePlex Editor supports the use of AVI files recorded without the CinePlex Studio system, which therefore does not contain embedded timestamps. To use these files, Frame markers must be generated before using CinePlex Editor.

- CinePlex Editor can also read certain other AVI files, but those AVI files must use the Motion JPEG method for encoding and storing the video frames.
D.6 Understanding Markers and Marker Occurrences

To use CinePlex Editor effectively, it is important to understand the difference between a marker and a marker occurrence. A marker is defined by its type and name. A marker occurrence is a specific insertion of a marker at a designated time. Each marker can have many marker occurrences associated with it. Before any marker occurrences for a given marker can be created, that marker must exist. To use concepts from object-oriented software methodologies, a marker corresponds to a class, and marker occurrences correspond to instances of that class.

Every marker has a marker type definition. Each marker occurrence stores at least one timestamp, along with other supplemental data, depending on the marker type. The following table describes each marker type and the information it stores for each occurrence:

<table>
<thead>
<tr>
<th>Marker Type</th>
<th>Abbr</th>
<th>Information Stored</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Only</td>
<td>T</td>
<td>Timestamp</td>
<td>Single happenings, where the only required information is the time of the happening. E.g. “Shock Applied”</td>
</tr>
<tr>
<td>Frame</td>
<td>F</td>
<td>Timestamp</td>
<td>Special time-only marker applied automatically by CinePlex Studio to associate a time with each video frame. <strong>Note:</strong> This marker always appears grayed out in the Define New Marker dialog box because it is system-generated.</td>
</tr>
<tr>
<td>Interval</td>
<td>I</td>
<td>Start Timestamp, End Timestamp</td>
<td>Denotes a time interval over which something occurred. E.g. “Stimulus Applied” or “Valid Trial”</td>
</tr>
<tr>
<td>Scalar</td>
<td>S</td>
<td>Timestamp, Value</td>
<td>Denotes a value (stored in a 16-bit number) at a given time. E.g. the Motion Measure produced by the CinePlex Studio Tracking Option.</td>
</tr>
<tr>
<td>Coordinates</td>
<td>C</td>
<td>Timestamp, X, Y</td>
<td>Denotes a pair of values (stored in 16-bit numbers) at a given time. E.g. Animal coordinates produced by the CinePlex Studio Tracking Option.</td>
</tr>
</tbody>
</table>
It is possible to open a quick reminder of the marker types and their abbreviations; see Quick Reference in “Help Menu” on page E-12. Throughout this manual, the marker types Interval, Level Interval, and Zone Interval are collectively referred to as interval-type markers or interval markers, as they share many common characteristics.

CinePlex Editor uses the concepts of both a selected marker and a selected marker occurrence; that is, one may open a dialog box to edit the characteristics of a selected marker, and one may delete or edit the selected marker occurrence. CinePlex Editor also uses the concept of current time and a closely related current video frame.

By default, whenever the current time is changed in CinePlex Editor, it automatically selects the most appropriate marker occurrence of the selected marker for the current time. However, to turn this behavior off, from the Tools menu select Options and on the General tab, click to clear the Select Marker Occurrence For Current Time checkbox.

### D.6.1 Marker Occurrences and the Marker Occurrences Window

This section includes descriptions of the CinePlex Editor facilities for displaying, generating, and editing marker occurrences.

The Activity window graphically shows where marker occurrences occur in time. The Video window and the Scalar window each show the data values associated with Coordinates and Scalar markers. But the Marker Occurrences window (see “Marker Occurrences Window” on page D-23) contains a concentration of
functionality for dealing with marker occurrences. The following Marker Occurrences window shows the numerical values of the marker occurrences for Position 1.

![Marker Occurrences Window](image)

This image shows the currently selected marker occurrence with a > in the leftmost column. The shortcut menu (see “Marker Occurrences Window” on page D-23) provides several operations that can be performed on marker occurrences. One may use other shortcut menu entries to select and copy text with marker occurrence information onto the Windows clipboard, and paste into other applications. In the Marker Occurrences window, the columns change according to the selected marker type as follows:

**Table D-2 Column Displays for Various Marker Types**

<table>
<thead>
<tr>
<th>Marker Type</th>
<th>Columns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Only, Frame</td>
<td>Time</td>
</tr>
<tr>
<td>Interval, Level Interval, Zone Interval</td>
<td>Start time, end time</td>
</tr>
<tr>
<td>Scalar</td>
<td>Time and value</td>
</tr>
<tr>
<td>Coordinates</td>
<td>Time, X, and Y</td>
</tr>
</tbody>
</table>

**Note:** Marker Occurrences are **identified** by time, so no two marker occurrences can have the same time. Attempting to add a new marker occurrence with the same timestamp as an existing marker occurrence causes CinePlex Editor to replace the existing marker occurrence with the new one, which deletes the old data values by overwriting them. Likewise, if an existing marker occurrence is edited by changing its timestamp to be the same as another existing marker occurrence, CinePlex Editor replaces the existing marker occurrence.

Also, when Scalar markers appear in the Marker Occurrences window, one can control the display format of the data values associated with each marker occurrence. One can use the shortcut menu items to display data values in decimal (the default), hexadecimal, or as Plexon VideoTracker bit fields, where the information appears as comma separated items as follows:
Bit15, Bit14, Bits 10 through 13, Bits 0 through 9

From the Marker Occurrences window shortcut menu, one can select Properties to open the Marker Occurrences View Properties dialog box:

By default, the dialog box displays the marker occurrences for the currently selected marker. However, one can click to clear the Use Selected Marker checkbox and select a different marker from the list to display the marker occurrences for that marker. When OK is clicked, the current Marker Occurrences window will switch to the one selected in the dropdown list. If there are more than one Marker Occurrences window open, this capability can be used to display marker occurrences for different markers simultaneously.

In the Display Format for Scalar Marker Values area, one can set the display format for Scalar marker values, which are described in Table D-2 on page 74. In the Marker Occurrences window, the items in the Value column change the display format chosen.

By default, whenever the current time is changed in CinePlex Editor, it automatically selects the most appropriate marker occurrence of the selected marker for the current time. However, this behavior can be turned off; from the Tools menu, click Options and then click the General tab; click to clear the Select Marker Occurrence For Current Time checkbox.
D CinePlex Editor User Interface

D.7 Correcting for Video Latency

If CinePlex Editor is being used to display data obtained using CinePlex Studio, be aware that there is a latency between the times of the video frames / position data sent from CinePlex Studio and the Neural Data.

**Understanding Timestamps for the Integrated CinePlex/OmniPlex® System**

The timestamp on a video frame is the time the shutter opens. The shutter remains open for the entire time of the exposure. Depending upon cameras, this can be from about 1 microsecond to the maximum time allowed for the frame rate selected. Light that hits the sensors during the exposure time is accumulated until the shutter closes. Therefore, the video data in a frame is the accumulated image that the sensor saw over the shutter-open period that started at the timestamp. This differs from neural data that is an instantaneous reading of voltage observed by the D/A converter at that instant in time.

Synchronized CinePlex/OmniPlex System video and neural data systems (when operated correctly) have video timestamps that are precisely synchronized with neural data timestamps for concurrent recordings. This synchronization occurs because both the CinePlex System and OmniPlex System are driven by the same clock and reset signals, and because the camera shutter openings are triggered at precise times. Sophisticated hardware and software in the CinePlex/OmniPlex System ensures synchronicity even over extended recording periods of several days. These systems currently require Plexon OmniPlex hardware and software together with CinePlex V3 hardware and software running on the same PC. Up to four triggered cameras (currently AVT) are also required. Timestamp granularity is 25 microsecond. The first frame timestamp is exactly one frame time after recording starts. Position and event data is computed for every frame and tagged with that frame’s timestamp.

**Understanding Video Frame Latency**

In CinePlex Studio, the camera takes some time to acquire and transmit each video frame to the Capture computer over the firewire cable. The CinePlex Studio computer will timestamp the frame as soon as it receives notification from the camera that the frame has been delivered, but our tests indicate that the camera takes approximately 21 milliseconds after the ‘shutter’ closes to deliver the frame. Therefore, the timestamps of the video frames and of the position data from CinePlex Studio are about 21 milliseconds after the actual frame. One way to think about this is that if something suddenly happens in the experimental arena, say an LED suddenly turns on, the video frame that first shows the LED illuminated will have a timestamp that is about 21 milliseconds later. Note also that there can be substantial jitter in this number, depending on when the LED turned on in relation to when the ‘shutter’ opened in the camera.

Also, there is a systematic offset that can add a constant amount to the latency of each frame, having to do with the exact time that is taken to be zero in the AVI file versus the PLX file recorded on a Plexon NDAQ or the Plexon Recorder
system. Because of this effect, the video latency for Recorder is measured to be closer to 33 milliseconds.

**Using the CinePlex Editor Latency Correction Feature**

CinePlex Editor contains a feature that will automatically subtract some amount of time from each video frame timestamp and each position timestamp when a project is first created. To activate this feature, select the **Latency Correction** tab of the **Tools – Options** dialog box and check the **Automatically compensate for video latency by adjusting Frame and Position Markers** box, and enter a amount of time to subtract from each timestamp:

![Latency Correction Tab](image)

The amount of time specified is always subtracted from the timestamps, so the entered number should always be positive. Note that this subtraction will only occur when the project is first created, when the Frame and Position Markers are initially created from the video and neural data files (see “How CinePlex Editor Creates Initial Project Files” on page D-69), or when a DVT file is imported. It is not performed when a CPJ file is read, or when data from a NEX file is imported. Note that the timestamp shift that is performed automatically is equivalent to the shift than can be performed manually using the **Tools | Shift Marker Occurrences**.

Note that applying this correction can shift Markers to have a negative timestamp near the beginning of files. When this happens, the timestamps will be assigned the value of 0.

In addition to the correcting for the camera latency, an independent correction for the tracking latency can be applied, as discussed in the next section.

**Note:** As of CinePlex Editor version 1.2.0, these latency corrections are now enabled by default, with a default correction of 21 milliseconds. If data have been analyzed using previous versions of CinePlex Editor, the timestamp shifts after upgrading to version 1.2.0. To return to pre-version-1.2.0 behavior, one can disable the corrections by unchecking the checkboxes.

**Note:** When CinePlex is being used with Plexon’s Recorder system, there was an issue with Recorder versions prior to 2.3.2 that could artificially increase this latency by up to 80 milliseconds. If using CinePlex Editor with Recorder, please upgrade the version of Recorder to version 2.3.2 or later. Also, use a video latency correction of 33 milliseconds as discussed above.
Note: When CinePlex Editor is being used with Plexon’s MAP system, leaving the MAP on overnight could result in excessive latency - much greater than 30 milliseconds. If the MAP has been left on overnight, it is better to reset the MAP system.
D.8 Aligning Tracker Coordinates to Frames

If neural and video data files are collected using a Plexon NDAQ and CinePlex Studio with tracking enabled, then the temporal relationship between Frame markers, the arrival of strobe codes to the MAP digital input card, and video tracker coordinates are depicted in the following image of the Activity window:

![Diagram showing frame marker, strobed, and position 1]

**Note:** Note: the above screenshot depicts the timing assuming that the automatic corrections for (see previous section) are not enabled.

When the video frame is available, CinePlex Studio immediately timestamps the file and stores the time in the AVI file along with the video frame image. When CinePlex Editor initially reads the AVI file, the time for each frame becomes a **Frame Marker** time, which appears as the blue tick marks in the previous image.

After CinePlex Studio acquires the video frame, it feeds the video image to the tracking algorithm. Some time later, the tracking algorithm determines the tracking positions and CinePlex Studio encodes the tracking positions using the VideoTracker protocol and outputs a burst of strobed data words. The time between the frame timestamp and the sending of the strobe codes depends on how quickly the tracking algorithms finish, but the first strobed data word always occurs before the start of the next video frame. The words within a burst are clocked out at a constant rate every two milliseconds.

When strobed data words arrive at the MAP, the MAP timestamps them as it reads them in, and then stores them as events in the PLX file. When CinePlex Editor in turn reads these strobed events from the PLX file, they become occurrences of a Scalar marker named **Strobed**; in the preceding image, these occurrences appear as brown tick marks. Also, if CinePlex Editor recognizes that the strobed codes are in VideoTracker protocol, it decodes them into occurrences of one or more Coordinates markers (see Table D-1 on page 72). CinePlex Editor then assigns times to the Coordinate marker occurrences. The assigned times are derived from the time of the first strobed event in each burst of strobed events. As a result, CinePlex Editor assigns times to the tracked positions that are later than the timestamps of the corresponding video frames; in the preceding image, the tracked positions (**Position 1**) are the red tick marks and the video frames are the blue tick marks.

This time offset between the frame time and the tracking coordinates, although realistic, is not desirable in some cases. For example, one can simplify subsequent analysis when the coordinates corresponding to a video frame are equal to the time of the video frame. One can do this with CinePlex Editor, by using the Snap-To Marker Occurrences tool described in “Snap-To Marker Occurrences” on page D-54.
To align frame times and tracking coordinates

1. To align the tracking coordinate Position n marker occurrences to video frames, on the Tools menu, click Snap-To Marker Occurrences.

   The Snap-To Marker Occurrences dialog box opens.

2. Select the Position n marker in the Marker To Adjust box. Leave the Snap-To Occurrences of Marker set to the default value Frame Marker.

3. Click Snap-to Previous Occurrence.

4. Click OK. A confirmation box will appear that specifies how many marker occurrences were moved.

After the Snap-to operation completes, the previous image becomes:

The red tick marks are now aligned with the blue tick marks. Thus, the tracker coordinate Position 1 occurrences are now aligned with the Frame Marker occurrences.

Note that position data imported from a DVT file is already timestamped with the time of the corresponding frame, so this correction is not required.

One can configure CinePlex Editor to automatically perform this snap-to previous operation for newly-created projects by checking the ‘Automatically snap Position Markers imported from PLX files to the previous Frame Marker’ checkbox in the Latency Correction tab of the Options dialog box. This correction is only automatically applied when the data is initially imported from a PLX file.
D.9 Interpreting Frame and Event Timestamps

An event timestamp indicates that the MAP detected the event within the prior 25 microseconds. This is illustrated by the diagram below.

![Diagram showing event timestamp and actual event occurrence.]

A frame timestamp shows when the shutter was opened. The shutter will remain open until the exposure time elapses.

**Note:** If the shutter is opened within the 25 microseconds prior to an event timestamp, it is possible that the visual evidence of the event will not be captured as illustrated by the diagram below. Referring to the diagram, if the event occurred prior to the shutter opening, the visual evidence will not be recorded.
D.10 Analyzing CinePlex Studio data with NeuroExplorer

As discussed in “Export to NEX” on page D-37, data can be exported from CinePlex Editor as a NEX file and read into NeuroExplorer. In this case, CinePlex Editor can perform latency corrections as described in the previous sections, and the data read into NeuroExplorer will be already corrected for latency.

However, a PLX file containing coordinates from CinePlex Studio can also be read directly into NeuroExplorer. NeuroExplorer can decipher the Video Tracker protocol strobe codes (See Appendix D) and turn them into continuous variables. In this case, the timestamps for the coordinates should be corrected for latency within NeuroExplorer. Note that since NeuroExplorer does not have access to the frame times (stored in AVI and DVT files), it needs to compensate both for the video latency (see “Correcting for Video Latency” on page D-76) and for the tracking latency (see “Aligning Tracker Coordinates to Frames” on page D-79) by subtracting a larger number from the position timestamps. To configure the latency correction, from the View menu select Data Import Options. In the Data Import Options dialog box, click the Plexon Files tab. In the Strobed Events area, enter a latency value in the Position events latency (seconds) field.

The default value for this latency correction in the screenshot is 75 milliseconds (appropriate for the Plexon Video Tracker product, but too high for CinePlex Studio). A more appropriate number is 31 milliseconds (21 milliseconds video latency plus about 10 milliseconds of tracking latency).
Appendix E
Navigating the Plexon User Interface

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E.1 Plexon User Interface

The Plexon® User Interface embodies a standard look-and-feel for Plexon software products. To illustrate the underlying concepts behind the look-and-feel, this appendix uses screenshots from Plexon’s CinePlex® Editor and CinePlex Studio applications. Although there will be differences in menus and toolbars between different applications, how to use, handle, and operate the user interface components will be fundamentally the same across future generations of Plexon’s software products including:

- CinePlex Studio
- CinePlex Editor
- Offline Sorter™

This appendix covers common functionality of the look-and-feel between different Plexon software applications. The discussion includes the following sections:

- Screen Elements
- Standard Menu Items and Dialogs
- Customization

E.2 Screen Elements

E.2.1 Menus

The menu bar of the application contains the names of all of the menus for the application. Each menu name has a letter underlined which indicates the hot-key combination for that menu. To activate a particular menu, click the left mouse button on the name or press and hold the ALT key while pressing the underlined letter. The image below is the main menu of CinePlex Editor.
Each menu of the Plexon User Interface contain menu commands and may also contain Icons, Hot Keys and a Tear-off Menu Handle as shown by the illustration below of the Edit menu of CinePlex Editor.

While all Plexon applications are shipped with their available menu commands organized into a set of menus, the contents of the menus can be customized and new menus can be created.

- **Icons** - Icons may be located immediately to the left of the menu commands. These icons will be displayed on the toolbar associated with the menu. In the example menu, there are icons associated with all but the last three of the menu commands. The presence of an icon next to a menu command means that the icon is also a label on a toolbar button and will execute the same command when clicked as the menu command on the menu.

- **Hot Keys** - Hot Keys are key combinations that will cause a menu command to execute without having to click the command on the menu. Typically, hot keys will contain two keys that must be pressed simultaneously for the combination to execute. The area at the far right of the menu commands may display the hot key combinations for the menu commands. In the example
menu, there is a hot key combination (CTRL + C) for the Copy command. Hot keys may be added or customized via the Tools-Customize dialog.

- **Tear-off Menu Handle** - The Tear-off Menu Handle is an area (the one containing the dots) at the top of the menu, present on many menus. The tear-off feature allows the quick creation of a toolbar that contains all of the commands in the menu that have command icons. You can hover the mouse over the tool to highlight it, drag the mouse to the toolbar area and place the menu as a toolbar there. The illustrations below show highlighting the Tear-off Menu Handle to begin dragging the toolbar, dragging the toolbar across the screen, and finally docking the toolbar in place.

E.2.2 Toolbars

Each toolbar has a dropdown button at the right that will allow you to add or remove buttons from toolbars and will also allow you to access the Customize dialog box. When you click the dropdown button the Add or Remove Buttons dropdown menu will appear as shown below.
The dropdown menu also has a dropdown button. Clicking that button displays a menu list of the available toolbars and a menu command to allow access to the Customize dialog box.

Expanding one of the toolbar menus will display all of the available toolbar buttons for that particular toolbar and a checkbox beside each one that will indicate whether or not the button is visible on the toolbar. There is also an option to reset the toolbar back to its factory default setting.

Clicking the Customize menu command will open the Customize dialog box. This dialog box is common to Plexon software applications but may have different content on the tabs according to the software application.
E Navigating the Plexon User Interface

For details on using the Customize dialog box, see “Customization” on page E-17

E.2.3 Windows

The image below shows a typical window title bar. It contains (from left to right) a Title, a Auto Hide button, a Maximize button, and a Close button.

• Auto Hide Button - The Auto Hide button “pins” a window to the screen to keep it visible or “rolls up” a visible window into a tab. When the window is pinned, the Auto Hide button points in a vertical direction. If the window is rolled up, the Auto Hide button points in a horizontal direction.

• Maximize Button - The Maximize button may not appear on all windows. It is the standard Windows® maximize button. Clicking the Maximize button on a window will maximize the original window and hide other windows occupying the same horizontal or vertical space. Clicking the Maximize button again will restore the previous layout. When clicked the image on the button toggles between one window and overlapping windows.

• Close Button - The Close button closes the window.
Plexon software applications often display several windows simultaneously. These windows may be resized by using standard resizing methods and may also be repositioned by dragging and dropping and by using **Docking Stickers**. The image below shows the repositioning of a window (denoted by the blue transparent rectangle) and various **Docking Stickers** (with red circles around them). These **Docking Stickers** allow you to dock the window being moved in one of several ways described below.

You can position a window by floating it, docking it at the desired docking sticker at a window edge or in a tab.

- **Floating a Window** - You can drag a window by the Caption Bar near the center of the screen and release it causing the window to float. Holding down the CTRL key while dragging will always float the window. Double-clicking on the Caption Bar will also float a window. Note that the size and position of the floating window is remembered.

  — **Rolled-up Windows** - Floating windows may be enabled for roll up up by pressing the **Auto Hide** button. The window will roll up when the focus is changed to a different window. The first image below shows a floating window before rolling it up. The second image below shows the rolled-up window after the focus has changed.
• **Docking a Window at the Application Frame** - When you begin to drag a window, a transparent blue rectangle appears to indicate the position of the window and the four Docking Stickers appear individually at each edge of the application frame to allow you to dock the window to the respective edge. To dock just move the mouse to the desired Docking Sticker and release the mouse button. The docked window will extend along the entire length of the edge to which it is docked. The image below shows all four screen Docking Stickers.

![Docking Stickers](image1)

• **Docking a Window at a Window Edge** - When you move the window inside another window, the window Docking Stickers appear inside the window grouped together near the center of the window. Releasing the mouse button while it is over one of these stickers (except the center one) will dock the moving window to the respective edge of the window associated with the window Docking Stickers. The image below shows the window Docking Stickers. Note that the shading of these Docking Stickers is different that the shading of the Docking Stickers in the previous image.

![Docking Stickers](image2)

• **Placing Windows into Tabs** - Releasing the mouse button over the center Docking Sticker will allow the moving window to occupy the same space as the window beneath and will create tabs along the bottom for switching the view between the two windows. The image below shows the Marker Occurrences window without sidebar tabs on the left. On the right, a Channels window has been placed into the same space by using the center docking sticker. Note that there are two sidebar tabs at the bottom of the window.
Hidden Windows - Docked windows whose access is not needed often can be hidden or “rolled up” by pressing the **Auto Hide** button. When hidden, the window is represented by a sidebar tab. Sidebar tabs may be located at the left, right, or bottom of the screen and indicate hidden windows. To show one of these windows, just hover the mouse over one of the tabs and the window will appear. The **File Info** window of **CinePlex Editor** opened by the sidebar tab is shown below on the left. If you click the **Auto Hide** control, the window will be pinned and
remain open after you move the mouse away from the sidebar tab as shown on the right. The Auto Hide button will also have changed direction and be pointed downward. Note also that the File Info sidebar tab is gone on the right image.

E.3 Standard Menu Items and Dialogs

In Plexon software applications, some menu items may have the same functionality across several applications. These items are standard menu items and consist of the Window menu, the Run menu, and the Help menu.

E.3.1 Window Menu

The Window menu contains three items: Theme, Layout, and Customize.
• **Theme** - Clicking on **Theme** displays a menu as shown below. A theme is a color scheme that is part of the look-and-feel of the user interface.

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— **Theme Group** - The top group of items are theme toggle items that may be selected to apply to the user interface look-and-feel. Only one of the themes may be selected at a time.

— **Text Below Toolbar Icons** - This item is a toggle item to show or not show text below the toolbar icons.

— **Hide Window Title Bars** - This item is a toggle item to hide or show window title bars.

• **Layout** - Clicking on **Layout** displays a menu as shown below. A layout is the size and placement of the windows on the screen. It also remembers the number and placement of toolbars.

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— **Reset to Default Layout** - Clicking on this item resets the layout to the factory default.

— **Load Layout Group** - Clicking on **Apply Layout 1** or **Apply Layout 2** applies one of the standard layouts to the user interface. Clicking on **Load Layout From File** will allow you to select a layout file to apply to the user interface.

— **Save Layout Group** - Clicking on **Save As Layout 1** or **Save As Layout 2** saves the current screen layout as one of the two standard layouts. You can also click **Save Layout to File** to save the current screen layout to a file that can be loaded by the **Load Layout From File** item.
E Navigating the Plexon User Interface

- **Customize** - Clicking Customize displays the Customize dialog box as shown below

![Customize Dialog Box](image)

For details on using the Customize dialog box, see “Customization” on page E-17.

E.3.2 Run Menu

The purpose of the Run menu is to launch other applications quickly. The Run menu will be populated by default with some common Plexon applications. To launch other applications from within the current application, you can add new entries to the Run menu. A sample Run menu is shown below. For additional information about customizing the Run menu, see “Run Menu Customization” on page E-21.

![Run Menu](image)

E.3.3 Help Menu

The Help menu contains four items: Help, Quick Reference, Web Update, and About XXXXX where XXXXX is the name of the application.
Help - Clicking Help displays the User’s Guide for the application.

Quick Reference - Quick Reference may be missing in some applications. When present, clicking Quick Reference displays a dialog box similar to the one shown below. The purpose of the Quick Reference dialog box is to show keys and mouse buttons that control some of the commonly used functions in various views. You can print it by clicking Print or close it by clicking OK.

Print – Click Print to print a copy of the Quick Reference.

Web Update - This item allows you to update software via the internet. Clicking Web Update will first check to see if an update is available. If an update is available, it will be downloaded and installed.

About - Clicking the About item displays the About dialog box. The text of the About item varies according to the application. The About dialog contains the version number and build data of the application, links to the Plexon website and support e-mail, and buttons for Licensing, System Report, and Manage File Extensions.
Navigating the Plexon User Interface

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**Licensing** - Clicking the **Licensing** button displays the **Plexon License Management** dialog box. The **Plexon License Management** window includes the complete licensing information for Plexon products. The window includes the following three areas: information, key testing, and code entry.
The information area includes information on license keys and a list of all the Plexon products and their licensed status on this computer.

If you have moved or added a key, the **Test the Key Again** button provides a convenient tool to test license keys to ensure they function correctly.

If you have more than one key installed, the **Next Key>>** and **<<Prev Key** buttons appear. You may use these buttons to cycle through and test all keys.

The code entry area is used to enter the unlock codes for optional programs and features. If you have licensed optional items, instructions for entering codes and testing keys are included with Plexon installation programs.

**System Report** - The purpose of the **System Report** button is to help Plexon Support diagnose problems by listing system information. Clicking the **System Report** button will first display a dialog box to allow you to display the system report on the monitor or save the report to a file that can be sent via E-mail to Plexon Support.

After selecting a choice, clicking **OK** will launch the standard Microsoft® System Information tool. The image below shows the System Information report displayed on the monitor.
**Manage File Extensions** - Clicking the **Manage File Extensions** button opens the **Manage File Associations** dialog box. The **Manage File Associations** dialog box allows you to review and select which file types are associated with Plexon software applications. For example, when the PLX file type is associated with **Offline Sorter**, double-clicking on a PLX file will open **Offline Sorter** and load that PLX file. If you have not installed some of the applications, their file extension radio buttons will be disabled.

**E.3.4 Messages Window**

The **Messages** window displays a log of timestamps and associated application events that Plexon Support can use for troubleshooting purposes.

**Note:** The Messages window is not available for all applications.
Right-clicking the mouse in the Messages window will display a right-click menu with the following items:

- **Erase** - This item clears the window of all messages
- **Pause** - This item stops the logging of messages
- **Show Debug Messages** - This item is a toggle to show or hide debug messages
- **Select and Copy All** - This item allows you to copy all of the messages to another application - such as a word processor
- **Save Log to File** - This item allows you to save the messages to a log file.
- **Mail Log to Plexon** - This item allows you to send the message log to Plexon for troubleshooting purposes

**E.3.5 Right-click Menus**

Most windows have right-click menus that control their behavior and options. To open a right-click menu, place the cursor inside a window and click and release the right mouse button. The right-click menu appears where the mouse is clicked. To select a menu item, move the cursor over it and click the left mouse button.

**E.3.6 Current Selections**

In grid-based windows, the currently selected item always appears with a >> or > in the left column of the appropriate grid-based window.

**E.3.7 Undo**

Plexon applications provide multiple undo levels. To undo an operation, on the Edit menu, click Undo or click the Undo button on the toolbar. You can undo operations that change the contents of the project file but may not undo operations that change the user interface options or colors.

**E.4 Customization**

Although the menus and toolbars offer a rich set of commands and functions that should meet the needs of most Plexon customers, the Customize dialog box also allows you to customize several areas of the interface should the need ever arise. This section describes the uses of the Customize dialog box.
To open the **Customize** dialog box, from the **Tools** menu, select **Customize**. The **Customize** dialog box contains several tabs. The images below show the **Customize** dialog box from CinePlex Editor and displays five tabs - **Toolbars**, **Commands**, **Keyboard**, **Run Menu**, and **Options**. Although the content of the tabs will vary according to the application, the functional operation of each tab is respectively the same across all Plexon software applications.

### E.4.1 Toolbars Customization

An image of the **Toolbars** tab follows:

![Customize dialog box]

- **Toolbars** - This box contains a list of the toolbars for the application. Click a toolbar checkbox to have it appear in the main application window.
- **New** - This button opens the **New Toolbar** dialog box. You can use this feature to create a custom toolbar for commands frequently used. Enter a toolbar name in the **Toolbar name** box.
- **Rename** - If you have selected a toolbar that was previously defined, click **Rename** to change the name of the toolbar. The **Rename Toolbar** dialog box displays.
- **Delete** - If you have defined a new toolbar and selected it, click **Delete** to remove that toolbar. There are no default values for newly defined toolbars. Standard toolbars may not be deleted. A confirmation dialog box displays.
- **Reset** - If you have selected a standard toolbar, click **Reset** to restore the toolbar to its default contents. If new buttons have been dragged to a toolbar, click **Reset** to restore the default version of the toolbar. A confirmation dialog box displays.
E.4.2 Commands Customization

The **Commands** tab is used to customize which commands are available in toolbars. An image of the **Commands** tab follows:

- **Categories** - This is a list of all the toolbar categories. Select a toolbar category to see the buttons in the **Commands** area.

- **Commands** - This area shows all the buttons and the associated menu commands that belong to the selected category. You can select the desired command and drag it to the toolbar.

E.4.3 Keyboard Customization

The **Keyboard** tab allows you to bind keystrokes to commands. An image of the **Keyboard** tab follows:
- **Category** - This is a list of all the main menu headings. Select a menu heading to category to see the associated commands in the **Commands** area.

- **Commands** - This is a list of all the commands associated with the selected main menu heading in the **Category** area.

- **Key assignments** - This displays the current key assignment for the command selected in the **Commands** area.

- **Press new shortcut key** - This allows you to enter a shortcut key combination for the command selected in the **Commands** area.

- **Description** - This area displays a description of the currently selected command in the **Commands** area.

- **Assign** - This button assigns the shortcut in the **Press New Shortcut Key** area to the selected command in the **Commands** area. If the shortcut key is already assigned to another command, a confirmation dialog box displays to allow or cancel the reassignment.

- **Remove** - This button removes the selected shortcut key in the **Key Assignments** area from the selected command in the **Commands** area.

- **Reset All** - This button removes all custom key assignments. A confirmation dialog box displays to allow or cancel the operation.
Procedure for Customizing Keystroke Shortcuts

1. From the **Window** menu, select **Customize**, and then click the **Keyboard** tab of the **Customize** dialog box.

2. Choose a category from the **Category** dropdown and from the **Commands** list, select the desired command to bind to a keystroke shortcut.

3. If there is already a key assignment listed in the **Key assignments** area, remove it by clicking the **Remove** button if so desired. You can also just reassign a new key combination to the selected command. (See Step 5)

4. Click the mouse in the **Press new shortcut key** area.

5. Click the **CTRL** or **ALT** key and hold it down while clicking another key. The dual key combination will be displayed in the **Press new shortcut key** area. This combination will be the key assignment for the selected command.

6. Click the **Assign** button to assign the key combination to the selected command. If there already is a key assignment for the command, a confirmation box will display to confirm or cancel the reassignment.

**Note:** In CinePlex Editor do not bind menu operations to keystrokes that are associated with markers. Use only **CTRL**- or **ALT**- key combinations to bind to menu items, as these key combinations cannot be associated with markers.

### E.4.4 Run Menu Customization

The **Run Menu** tab allows you to manage menu items on the **Run Menu**. An image of the **Run Menu** tab follows:

- **Menu contents** - This is a list of all the menu items in the **Run Menu**. Select an item to see its characteristics in the **Command**, **Arguments**, and **Initial Directory** areas.
E. Navigating the Plexon User Interface

- **Buttons** - The toolbar buttons allow you to add a new menu item, delete a selected menu item, move the selected menu item upward in the list, and move the selected menu item downward in the list.

- **Command** - This area contains the name of the file that runs when the menu item is selected from the Run Menu. The browse button opens the standard Open dialog box filtered for executable files.

- **Arguments** - This is a list of all the arguments to be passed to the file in the Command area, if any. The browse button opens the standard Open dialog box filtered for all files. When applicable, the symbol “%I” can be used to denote the current document.

- **Initial Directory** - This contains the path of the file in the Command area. The path allows the system to find the file and execute it. The Browse button opens the standard Browse For Folder dialog box.

**Procedure for Customizing the Run Menu**

1. From the Window menu, select Customize, and click the Run Menu tab.
2. To add a menu item, click the New icon, enter the command in the Command text box, enter any arguments in the Arguments text box, and set the applications directory in the Initial Directory text box. In each case use the appropriate Browse button at the right of the text box. The Browse button for the command opens the standard File Open dialog box filtered for executable files. The Browse button for the arguments opens the standard File Open dialog box filtered for all files. Then Browse button for the initial directory opens the Browse for Folder dialog box.
3. To delete a menu item, select it and click the Delete button.
4. To reorder the menu items, select a menu item and use the Up and/or Down arrow buttons to reorder.

**E.4.5 Options Customization**

An image of the Options tab follows:
• **Personalized Menus and Toolbars** - This area contains two check boxes and a button. The application will hide infrequently used menu items, but you may customize the display of menu items using these two checkboxes. If you check the **Always show full menus** checkbox, the application will always show full menus and the **Show full menus after a short delay** checkbox will be disabled. If you do not check the **Always show full menus** checkbox, there will be the option of checking or clearing the **Show full menus after a short delay** checkbox. The **Reset menu and toolbar usage data** button will allow you to delete the record of commands used in the application and restore the default set of visible commands to the menus and toolbars. A confirmation dialog displays.

• **Other** - This area contains three checkboxes and a dropdown list. If you check the **Large icons** checkbox, the application will use large icons on the toolbar. If you check the **Show Screentips on toolbars** checkbox there will be the option of checking the **Show shortcut keys in Screen Tips** checkbox. The **Menu animations** dropdown list allows you to select the type of animation to be used on menus that have animation.
Appendix F
Troubleshooting

F.1 Physical Installation Issues ..................................................... F-2
F.2 Other Issues ........................................................................... F-3
CinePlex® Version 3 is a powerful, complex product that gives its users extensive control over the video portions of their neural data collection process. This complexity gives rise to possible interactions and issues that were not present in earlier versions. For that reason Plexon® has compiled this list of common problems reported from the field, together with their normal solutions. If the steps here do not solve the problem, or if the problem is not listed, please contact Plexon Support at support@plexon.com or +1-214-369-4957.

F.1 Physical Installation Issues

In general, all of the following should be checked when unexplained problems are occurring. For more detailed installation instructions of CinePlex V3 hardware, please refer to the relevant documents.

Missing/Improper Wire and Cable Connections - Single Systems

Be sure that all required cable connections are in place and tight. Unpredictable results may occur if they are not. See Appendix A, Cabling Guide for complete detailed instructions for cabling CinePlex. The most likely items to check are:

1. Short purple wire from TIM card nose board to the XS2 BNC connector on the TIM card.
2. Trigger cable(s) from the AccesIO tail board to the camera(s).
3. FireWire cable(s) from the FireWire card in the computer to the camera(s). If there are two cameras, there must be an empty FireWire socket between the two connections to the FireWire board or maximum frame rates will not be achievable.
4. Control cable from the TIM card nose board to the AccesIO tail board. If this cable is not in place, video frames may not be clocked and/or Studio may not start recording correctly.

Missing/Improper Wire and Cable Connections - Synchronized Systems

Cabling is slightly different when CinePlex and MAPs are deployed as multiple synchronized systems using a Quad MAP Controller (QMC). Again, be sure that all required cable connections are in place and tight. This includes:

CAUTION
Never plug or unplug a camera FireWire cable with the PC Power ON. Permanent damage to the camera may result.
1. BNC cable and start button to the “BUTTON” input on the QMC OR BNC cable from the “PULSE” input on the QMC to an external experiment control system.

2. Control cable from the Master MAP TIM nose board to the QMC “CPX CTRL IN” socket.

3. Control cables from the QMC “CPX CONTROL OUT” for each system to their respective AccesIO tail boards. If this cable is not in place, video frames may not be clocked and/or Studio may not start recording correctly.

4. BNC Start cable from the QMC “START” socket to the “XS2” BNC connector on the TIM card on each synchronized MAP system.

5. BNC clock cable from the Quad MAP controller “CLK OUT” connector to the “Remote CLK” on each of the respective TIM boards. Also make sure that the toggle switch above these connectors is in the down position to select the remote clock.

6. Optionally, digital input signals from an external system can be input to the “DIGITAL INPUT” socket on the QMC where they are made available on the “DIGITAL OUTPUT” sockets to all MAP boxes.

7. Trigger cable(s) from the AccesIO tail board to the camera(s).

8. FireWire cable(s) from the FireWire card in the computer to the camera(s). If there are two cameras, there must be an empty FireWire socket between the two connections to the FireWire board or maximum frame rates will not be achievable.

Cables Too Short between Camera(s) and MAP/CinePlex Computer

Plexon supplies several lengths of these cables from 7 feet (2 meters) to 26 feet (8 meters). Please contact Plexon if one of these standard lengths will work in the installation. Note that cable lengths over 26 feet result in intermittent video signals at higher frame rates and are NOT RECOMMENDED.

Unstable Camera Mounting

Camera mounts must be stable or the resulting video data will shake and not be repeatable. This can be the case, for example, when a tripod is used to mount a camera, instead of the preferred wall or ceiling mount. Please refer to Appendix B, Optimizing Camera and Lens Usage for the Experiment.

F.2 Other Issues

General Problem Solution - No Video from Camera and Other Problems

The correct starting sequence must be applied to the MAP box, Sort Client, and CinePlex Studio. Not following the sequence completely is the cause of many types of errors, including no video being shown from the cameras. The startup sequence is as follows:
1 Power up the MAP.

2 Power up the computer, log in as Administrator, bring up the Server program, and then bring up the Sort Client program. Select the desired Parameters file.

3 In Sort Client, press START button and then the start recording triangular icon. Then press the stop recording rectangular icon.

4 Bring up CinePlex Studio. Verify that video is showing and select a tracking mode. Adjust parameters so that objects are being tracked successfully.

5 Contact Plexon support if problem is not resolved.

**Troubleshooting**

**Error Messages While Running the Software Installation Package**

The installation package adds programs and DLLs to the system. Therefore, the installation software:

1 Must be run from a computer account with administrator privileges.

2 Cannot be installed on a Vista computer.

3 Cannot be installed on a 64 bit computer.

4 Must be downloaded to and run from a local hard drive. Removable drives, including USB flash drives and USB hard drives, are not acceptable. Neither are networked drives.

5 Contact Plexon support if problem is not resolved.

**Antivirus Software**

Some MAP/CinePlex Systems come from Plexon with antivirus software pre-installed. The system has been tested with this antivirus software in place and should operated without problem as long as software and update settings are not changed. If problems occur that can be traced to the pre-installed antivirus software, please contact Plexon Support. It could be that a new set of virus signature files has caused some CinePlex components to be flagged as untrustworthy.

Please do not install any other antivirus software on the MAP/CinePlex System computer without consulting Plexon Support first. There are two reasons for this:

1 First, some antivirus tools have been know to quarantine or remove key components of the CinePlex System, rendering it unusable. A reinstallation of the CinePlex software will be required after the antivirus tool is removed from the computer.

2 Second, periodic downloads of updates or periodic scans for infections can disrupt video streams and processing, causing lost frames and delayed events.

3 Contact Plexon support if problem is not resolved.

**Studio Will Not Start At All**

There can be many causes for Studio failing to start when its icon is clicked or displaying an error and failing to start when OK is clicked. The most common causes and their solutions are shown below.
1 Missing CinePlex license key. Obtain or find the correct license key and restart CinePlex.

2 If CinePlex still will not start and reports a missing license key, install the Sentinel drivers (this is done by the CinePlex installation software or by running the file C:\Program Files\Plexon Inc\CinePlex\Common Files\Sentinel System Driver Installer 7.4.0.exe).

3 If CinePlex reports missing DLLs, reinstall CinePlex. All the required DLLs are in the installation package.

4 Contact Plexon support if problem is not resolved.

**Studio Will Not Start In or Switch to Camera Mode**

There can be many causes for Studio failing to go into camera mode. The most common causes and their solutions are shown below.

1 Missing MAP and/or CinePlex license key. Obtain or find the correct license key, install the Sentinel drivers (this is done by the CinePlex installation software), and restart CinePlex.

2 Missing or inoperative IO card or drivers.

3 Camera cables are loose or unplugged. Power all components of the system down, then check and reseat both ends of the two cables to the camera. Power the system back up, and follow the normal startup steps.

4 Contact Plexon support if problem is not resolved.

**Studio Cannot Find AccesIO Drivers**

1 Check for and disable any antivirus software. If the AccessIO drivers are in quarantine, restore them.

2 Try running Studio again. If the system still cannot find the AccesIO drivers go on the next step.

3 Reinstall CinePlex.

4 Contact Plexon support if problem is not resolved.

**No Video in Studio**

1 Sort Client must have a valid configuration file and the button labeled “START” must have been pushed. Until this has been done, no CinePlex
Troubleshooting

Clock (or MAP clock from which it is derived) is being generated, so there is not video frame trigger.

2 After powering the system down, check the camera cables, especially the CinePlex System control cables.

3 Power the system back up and follow the normal startup steps.

4 If there is still a problem ensure that the manual iris control on the lens is fully open.

5 If the problem is still not resolved, there is a standalone un-triggered tool that will display video from the camera(s) if it is connected correctly and operational. Open the file below:

   C:\Program Files\Plexon Inc\CinePlex\Common Files\AVT_SmartView_1_8.exe

6 If there is video for a particular camera using this tool, the camera and its FireWire cables are OK, and something is wrong with MAP cabling or operation. If no video, contact Plexon Support.

Cannot Focus the Video Image

The video is present, but blurry and cannot be focused at any zoom or focus setting. Note that the nearest focus for Plexon supplied lenses is from 0.2 to 1.6 meters depending on the lens.

1 Check for the presence of an annular spacer between the lens and the camera. The spacer should be present if the lens is a C-mount lens like Plexon’s H6Z0812. The spacer should be absent for CS-mount lenses like the H32Z4512.

2 Adjust the zoom and focus rings on the lens until a clear picture is obtained. See figure above.

3 Contact Plexon support if problem is not resolved.

Slow Video in Studio

The video is present, but is updating very, very slowly - perhaps once every several minutes.
1 Remove the TIM card and check that the DIVCLK jumper is on the 1 MHz position instead of the 1 kHz setting. If not, move it to the 1 MHz setting.

2 Contact Plexon support if problem not resolved.

Filtering Video

- Video is present, but the image is flickering.

1 Turn off any fluorescent lights illuminating the arena and use incandescent lights instead. If the flickering goes away, there may be problems with the fluorescent bulbs themselves, the starters, or the ballast. If fluorescent fixtures must be used, these problems must be fixed. Otherwise, look for alternative lighting sources.

2 Contact Plexon support if problem is not resolved.

Arena is Too Small or Too Large within the Video Image

- Once video has been obtained, the camera and lens must be adjusted so that the maximum dimension of the arena nearly fills the long dimension of the video image while ensuring that all other parts of the arena are within the video image as well.

1 If the arena image is too small, move the camera closer to the arena (outside of the near limit) or adjust the zoom ring towards the T (telephoto). Then adjust the lens focus ring until the video image is clear, if possible.

2 If the arena image is too large, move the camera away from the arena (within the physical limits of the environment) or adjust zoom ring towards the W (Wide Angle). Then adjust the lens focus ring until the image is clear, if possible.

3 Contact Plexon support if the arena cannot be adjusted to fill the video window.

Studio Will Not Start Recording When the Sort Client Start Icon is Pushed

1 Check that the Rasputin Datafile Options are set up for CinePlex System operation. If Sort Client does not have these options available, contact Plexon Support to obtain the latest version.

2 Check that Studio is in the armed mode, waiting for Sort Client to start recording.

3 Check cables, especially the control cables - see the Physical Installation section of this document.

4 Check that the disk selected for recording video files is not full.

5 Contact Plexon support if problem is not resolved.

No Strobed Data Showing in Sort Client after Initial Startup

- Usually, this occurs because the correct starting sequence has not been applied to the MAP box, Sort Client, and CinePlex Studio. The startup sequence is detailed in the section above General Problem Solution - Startup Sequence Not Followed.
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1. Follow the start sequence. Go to LED or Markers mode. Press the PLX button next to up to three colors.

2. In Sort Client, ensure that the Strobed Data box is checked on the Settings/Events tab. Press the Activity tab icon so that tab appears.

3. Scroll down to the bottom of the Activity tab window and verify that strobed data hash marks are being displayed.

4. Earlier version of Sort Client may not always display strobed data even though it is being received and written to the PLX data file successfully. Use the section below to verify strobed data in earlier versions of Sort Client.

5. Contact Plexon support if problem is not resolved.

No Strobed Data Showing in Earlier Versions of Sort Client - Use VTViewer

Sometimes, strobed data may not appear on the Activity tab after recording has been started. This is due to a display fault in earlier versions of Sort Client. The simple VTViewer client may be used to verify the generation of strobed data in this case.

1. Use the VTViewer icon or open the file below (on the MAP/CinePlex System computer) to bring up the VTViewer program
   C:\Program Files\Plexon Inc\CinePlex/Common Files\VTViewer.exe

2. Drop down the File menu and select the Connect option.

3. If the connection to Sort Client has been successful, colored spots representing current reported positions of the tracked objects will appear on the VTViewer grid.

4. If no colored spots are shown, please contact Plexon support.

Live Video Being Corrupted or Neural Data Being Dropped

Sometimes the live data will be corrupted or neural data will be dropped.

1. Try reducing monitor count, monitor resolution, or both.

2. If cards have recently been added to the PC bus, remove them to see if the problem is solved.

3. Contact Plexon Support for help in rearranging the order that existing cards are plugged into the PC bus.

Dropped Frame Count Non-zero While Recording

When the MAP/CinePlex System computer is heavily loaded causing available video buffering to fill, video frames may be dropped. The count of dropped frames is incremented each time this happens. This is not a normal condition and probably indicates that the computer is being asked to perform more than MAP/CinePlex System processing.
1 Stop running all unnecessary applications on the computer while recording. This includes CinePlex Editor, which can initiate intensive hard drive activity. Use the Task Manager to display and end unneeded tasks.

2 Disable scheduled tasks such as backup and Windows® Update. These can cause dropped frames when they run. Use the Task Scheduler to view all tasks. Contact the system administrator to disable unwanted tasks.

3 Internet activity, especially that involving heavy downloads such as from YouTube or similar sites should be prohibited on the MAP/CinePlex System computer. To avoid this possibility Plexon recommends placing the computer on a subnet isolated from intensive internet traffic.

4 If dropped frames still persist after these steps, please contact Plexon Support.

F.3.16 Other Typical Problems and Solutions

This section includes a list of some of the other typical problems with remedies for each one.

Note: The following problem refers to CinePlex Capture (earlier version of CinePlex Studio).

The following dialog appears when trying to run CinePlex Capture:

1 If the following CinePlex Capture dialog box appears after starting CinePlex Capture, read the instructions in the box. Verify the camera connections as detailed in the steps that follow.

2 Check the 1394 cable between the camera and the CinePlex Capture computer. Make sure the cable is undamaged. Make sure to connect the cable to the “In” port on the camera. Do not connect the cable to the “DaisyChain” port on the camera.

3 Make sure the camera is the same camera that Plexon shipped with the CinePlex Capture computer. CinePlex cameras and computers are uniquely calibrated to each another and they are not interchangeable.
The video preview display is black

1. Set the manual iris control on the camera by twisting middle ring (iris) on the camera lens from closed to open.

2. From the File menu, click Set Defaults.

The video preview display is out of focus

1. Set the zoom and the focus controls on the camera by twisting the outer and inner rings on the camera lens until a clear picture displays in the Video window.

2. On CS mount cameras, ensure that the C to CS adaptor ring is not installed between the lens and the camera.

Dropped Frame Counts

1. Stop running all unnecessary applications on the computer while recording. This includes CinePlex Editor, which has file intensive activity. Use the Task Manager to display and end unneeded tasks.

2. Disable tasks such as backup and Windows Update. These can cause DFC increments when they run. Use the Task Scheduler to vie all scheduled tasks.

3. Place the CinePlex System computer on a subnet isolated from intensive internet traffic.

4. If the problem persists, please contact Plexon Support.

For details on DFC counts, see “Monitoring the Video During a Recording Session” on page 51.
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