

## Template Sorting

Template Sorting is performed using the waveform amplitudes in raw AD units.

The MAP system has:

12-bit A/D conversion ( $2^{12}=4096$ )

40 kHz (25 $\mu$ s) digitizing frequency

Therefore, the AD values of waveform and template amplitudes are integers between  $-2047$  and  $+2048$ . Since the zero-to-peak voltage range for the A/D converter is 3V,

$$\text{Magnitude of signal at electrode (in mV)} = \left( \frac{3000\text{mV} \cdot \text{ADvalue}}{2048 \cdot \text{TotalGain}} \right)$$

Let,

waveform =  $w = [w_1, \dots, w_N]$

template =  $t = [t_1, \dots, t_N]$

where

$w_i$  and  $t_i$  values are in AD units (between  $-2047$  and  $+2048$ )

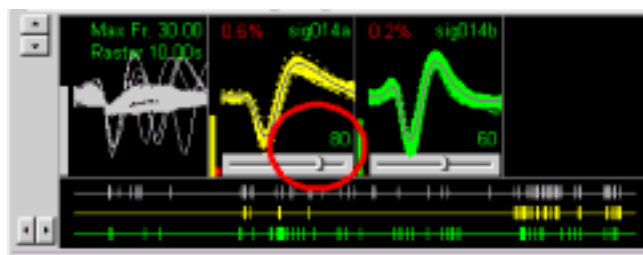
$N$  = # digitized data points

The distance measure ( $d_w$ ) between a waveform and a template is the square root of the mean sum of square error:

$$d_w = \sqrt{\frac{1}{M} \sum_{i=1}^M (w_i - t_i)^2}$$

where  $M$  is the sort width for the current channel in terms of the number of data points.

The template threshold is set by the slider in the Units Display in the SortClient:



The waveform is accepted if Template Threshold  $< d_w$ .

# Adaptive Template Adjustment Algorithm

There are 2 parameters that control the template adjustment:

Waveform Weight (W)  
Update Template Threshold (T)

The template adjustment works only if Waveform Weight =  $W > 0$ .

Let,

waveform =  $w = [w_1, \dots, w_N]$   
template =  $t = [t_1, \dots, t_N]$

where

$w_i$  and  $t_i$  values are in AD units (between  $-2047$  and  $+2048$ )  
 $N = \#$  digitized data points

A temporary template is made for each unit in each channel.

temporary template =  $s = [s_1, \dots, s_N]$

The temporary template is initially set to the current template:

$$s=t$$

For every new waveform ( $w$ ) received, the temporary template is updated according to a weighted average:

$$s_{new} = s_{old} \cdot (1 - W) + t \cdot W$$

$$\text{(i.e., } s_i = s_i \cdot (1 - W) + t_i \cdot W, \quad i = 1, \dots, N)$$

The new temporary template ( $s$ ) is compared with the existing template ( $t$ ):

$$d_t = \sqrt{\frac{1}{M} \sum_{i=1}^M (s_i - t_i)^2}$$

where  $M$  is the sort width for the current channel in terms of  $\#$  of data points:

The template for the current channel is updated (set equal to the temporary template) when  $d$  exceeds the distance measure ( $d$ ) exceeds the Update Template Threshold (T). That is,

If  $d_t > T$ ,

Then  $t$  is set equal to  $s$  ( $t = s$ ).