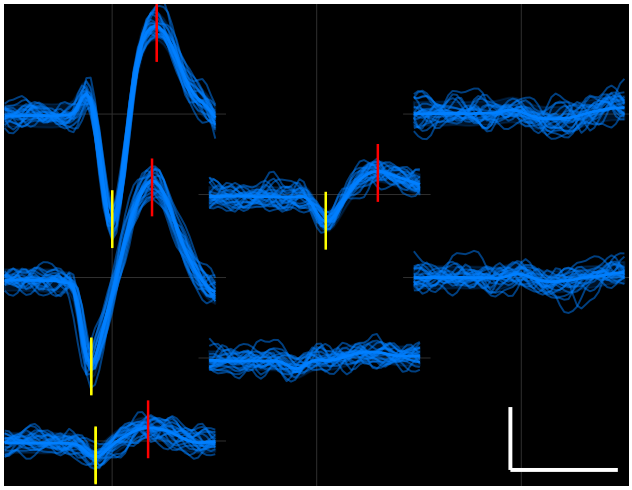

Figure 3.5: Spike peaks are not necessarily simultaneous across all nearby channels. 20 spikes from the same neuron from ptc22.tr1 are plotted. The top left channel is the primary channel (with maximum S_{pp}), and is also the top left site of the polytrode. Yellow markers denote the primary peak on each channel. Red markers denote the later secondary peak. Markers are aligned to the template mean, but each spike deviates slightly. All channels within 150 μm of the primary channel are shown, but the local peaks of channels without markers were too small and inconsistent to mark in this overplot display. Scale bar: 0.5 ms, 100 μV. Channel spacing: 65 μm.

the same timepoint was used as that on the primary channel. When searching for corresponding peaks, sign was ignored. This allowed for polarity inversion across channels, which could occasional occur.

Manual inspection of hundreds of detected spikes and minutes worth of raw data found little or no apparent detection errors, whether false positives or negatives. Errors were only found during clustering, in which many thousands of spikes were considered at a time. By nature, only false positives could be found during clustering. Even then, false positive detection errors were around 1%. Many apparent errors were alignment errors that were easily corrected (Section 3.7).

3.5 Spatial localization

Once detected, each spike was localized to a 2D position along the polytrode surface. A 2D circularly symmetric Gaussian was fit to the spatial voltage distribution of each spike. Specifically, V_{pp} was extracted on each included channel. The 2D Gaussian model was initially centered on the mean (x, y) position of the V_{pp} weighted channel coordinates. Although some of the fields were elliptical, a circularly symmetric Gaussian with a single σ (with $\sigma \equiv \sigma_x \equiv \sigma_y$) was chosen to reduce the number of free parameters. This was necessary for model stability given the limited amount of spatial data provided by each spike, especially in the x direction which had at most three unique values for a 3 column polytrode. σ was initialized to a value of 50 μm, which was roughly the average spatial spread across all spikes (Figure 4.10). V_{pp} at any point (x, y) along the plane of the polytrode was modelled by

$$\hat{V}_{pp}(x, y) = Ae^{-\frac{(x-\mu_x)^2+(y-\mu_y)^2}{2\sigma^2}}, \quad A = V_{pp}(x_0, y_0) \tag{3.3}$$

where (x_0, y_0) are the coordinates of the primary channel. A was fixed to the V_{pp} on the primary channel, which was usually also the maximum V_{pp} of all the included channels. This further reduced