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Optimal filter design for threshold-based spike sorting of high-density neural probe data

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An innovative filter design method is proposed for threshold-based spike sorting of high-density neural recordings. Threshold-based spike sorting is the process of assigning each detected spike in an extracellular recording to its putative neuron, using only linear filters and simple thresholding operations. The low computational complexity of threshold-based spike sorting makes it interesting for real-time (hardware) implementations with potential applications in the field of brain machine interfaces. The proposed method extends our earlier work on discriminative template matching and avoids the need for a prior heuristic definition of an interference covariance matrix. A new optimal filter design objective function is proposed, which automatically selects interference-dominated signal segments based on the output signal of the filter under design. This new method leads to filters that are signal-to-peak-interference ratio (SPIR) optimal. The method is validated on ground truth data recorded in-vivo. It is shown that the filter design method outperforms a heuristic design method proposed earlier.