Multiple Testing of Local Maxima for Detection of Peaks in 1D

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A common problem in signal/image analysis is to find local significant regions, either for a single signal/image or for the difference between two or more signals/images. In this talk, I describe how to approach this inference problem from a multiple testing point of view, and emphasize the need to make inferences about spatial features such as peaks rather than individual pixels or voxels. Focusing on the 1D case, I propose a formal procedure for detecting smooth peaks buried in stationary noise, where both the height and location of the peaks are unknown. The procedure, involving kernel smoothing and testing of local maxima, is easy to implement and takes advantage of existing multiple testing procedures, so that global error rates are controlled. Interestingly, the optimal bandwidth corresponds to the "matched filter" principle, where the kernel size should be close to that of the peaks to be detected. The method is illustrated in 1D time series data of neuronal recordings.