**Multiple testing of local maxima for detection of peaks in random fields**

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**Abstract:**

Detection of sparse localized signals embedded in noise background is an important problem in statistics, with applications in many scientific areas such as neuroimaging, microscopy and astronomy. In this talk, I will present a topological multiple testing scheme for detecting signals (peaks) in images under stationary ergodic Gaussian noise, where tests are performed at local maxima of the smoothed observed signals. Two methods are developed according to two different ways of computing p-values: (i) using the exact height distribution of local maxima, available explicitly when the noise field is isotropic; (ii) using an approximation to the overshoot distribution of local maxima above a pre-threshold, applicable when the exact distribution is unknown, such as when the stationary noise field is non-isotropic. The algorithms, combined with the Benjamini-Hochberg procedure for thresholding p-values, provide asymptotic strong control of the False Discovery Rate (FDR) and power consistency, with specific rates, as the search space and signal strength get large. Simulations show that error levels are maintained for nonasymptotic conditions and that power is maximized when the bandwidth of smoothing kernel is close to the theoretical optimal result. The methods are illustrated in a data example of functional magnetic resonance images of the brain.

**Biography:**

Dr. Cheng studies statistical inference of random fields and dependent data, with applications in image analysis, signal detection, neuroscience and astronomy. He is also interested in probability theory, focusing on Gaussian random fields and extreme value theory. Dr. Cheng received his PhD in statistics from the Department of Statistics and Probability at Michigan State University in 2013. Prior to joining TTU, he did postdocs in the Department of Statistics at NC State University and the Division of Biostatistics at UC San Diego.

