



# THE UNIVERSITY OF CHICAGO

Department of Statistics

## SCIENTIFIC AND STATISTICAL COMPUTING SEMINAR

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ANTHEA MONOD

Department of Statistics  
Duke University

### Statistical Estimation of Random Field Thresholds Using Euler Characteristics

THURSDAY, February 12, 2015 at 4:30 PM  
133 Eckhart Hall, 5734 S. University Avenue

#### ABSTRACT

We introduce Lipschitz-Killing curvature (LKC) regression, a new method to produce  $(1-\alpha)$  thresholds for signal detection in random fields that does not require knowledge of the spatial correlation structure. The idea is to fit the observed empirical Euler characteristics to the Gaussian kinematic formula via generalized least squares, which quickly and easily provides statistical estimates of the LKCs — complex topological quantities that are otherwise extremely challenging to compute, both theoretically and numerically. With these estimates, we can then make use of a powerful parametric approximation of Euler characteristics for Gaussian random fields to generate accurate  $(1-\alpha)$  thresholds and p-values. Furthermore, LKC regression achieves large gains in speed without loss of accuracy over its main competitor, warping. We demonstrate our approach on an fMRI brain imaging data set. This is joint work with Robert Adler (Technion), Kevin Bartz (Renaissance Technologies), and Samuel Kou (Harvard).

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#### Organizers:

Lek-Heng Lim, Department of Statistics, [lekheng@galton.uchicago.edu](mailto:lekheng@galton.uchicago.edu), Ridgway Scott, Departments of Computer Science and Mathematics, [ridg@cs.uchicago.edu](mailto:ridg@cs.uchicago.edu), Jonathan Weare, Department of Statistics and The James Franck Institute, [weare@uchicago.edu](mailto:weare@uchicago.edu). SSC Seminar URL: [http://www.stat.uchicago.edu/seminars/SSC\\_seminars.shtml](http://www.stat.uchicago.edu/seminars/SSC_seminars.shtml).

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