THE UNIVERSITY OF CHICAGO | DEPARTMENT OF STATISTICS

PHD DISSERTATION PROPOSAL PRESENTATION

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"Non-Asymptotic Analysis of Ensemble Kalman Updates"

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Jones 111, 5747 S. Ellis Avenue

ABSTRACT

Many modern algorithms for inverse problems and data assimilation rely on ensemble Kalman updates to blend prior predictions with observed data. Empirically, Ensemble Kalman methods often perform well with a small ensemble size, which is essential in applications where generating each particle is costly.

This talk will first describe a novel non-asymptotic analysis of ensemble Kalman updates that rigorously explains why a small ensemble size suffices if the prior covariance has moderate effective dimension. We present our theory in a unified framework, comparing several implementations of ensemble Kalman updates that use perturbed observations, square root filtering, and localization. Extensions to the multi-step Kalman update setting will also be discussed.

In the second part of the talk, we motivate the statistical study of the Knothe-Rosenblatt (KR) rearrangement - a multivariate extension of the increasing rearrangement between measures. In the recent literature, KR maps have proven to be useful in a myriad of tasks including: density estimation, Bayesian inference and generative modelling. They have also been proposed as a natural non-linear generalization of the ensemble Kalman update. Despite their empirical success, very little is known about their statistical properties, particularly in the high dimensional setting in which there exist fewer samples than features. We focus on a specific family of parameterizations that can be used to learn KR maps efficiently and which may be amenable to statistical analysis.