THE UNIVERSITY OF CHICAGO

# COMPUTATIONAL AND APPLIED MATHEMATICS COLLOQUIUM

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## A Conditional Gaussian Framework for Uncertainty Quantification, Data Assimilation and Prediction of Nonlinear Turbulent Dynamical Systems

THURSDAY, February 14, 2019, at 4:00 PM
Jones 226, 5747 South Ellis Avenue

## ABSTRACT

A conditional Gaussian framework for uncertainty quantification, data assimilation and prediction of nonlinear turbulent dynamical systems will be introduced in this talk. Despite the conditional Gaussianity, the dynamics remain highly nonlinear and are able to capture strongly non-Gaussian features such as intermittency and extreme events. The conditional Gaussian structure allows efficient and analytically solvable conditional statistics that facilitates the real-time data assimilation and prediction.

This talk will include three applications of such conditional Gaussian framework. The first part regards the state estimation and data assimilation of multiscale and turbulent ocean flows using noisy Lagrangian tracers. Rigorous analysis shows that an exponential increase in the number of tracers is required for reducing the uncertainty by a fixed amount. This indicates a practical information barrier. In the second part, an efficient statistically accurate algorithm is developed that is able to solve a rich class of high-dimensional Fokker-Planck equation with strong non-Gaussian features and beat the curse of dimensions. In the last part of this talk, a physics-constrained nonlinear stochastic model is developed, and is applied to predicting the Madden-Julian oscillation indices with strongly non-Gaussian intermittent features.

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**Organizers:**
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CAM Colloquium URL: https://cam.uchicago.edu/seminars/colloq/index.shtml.

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