THE UNIVERSITY  OF HONG KONG

Institute of Mathematical Research
Department of Mathematics

Numerical Analysis Seminar

An efficient and statistically accurate Lagrangian data assimilation algorithm with applications to discrete element sea ice models

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Abstract

In this talk, I will introduce an efficient data-driven statistically accurate reduced-order modeling algorithm that significantly accelerates the computational efficiency of Lagrangian data assimilation. The algorithm starts with a Fourier transform of the high-dimensional flow field, which is followed by an effective model reduction that retains only a small subset of the Fourier coefficients corresponding to the energetic modes. Then a linear stochastic model is developed to approximate the nonlinear dynamics of each Fourier coefficient. Effective additive and multiplicative noise processes are incorporated to characterize the modes that exhibit Gaussian and non-Gaussian statistics, respectively. All the parameters in the reduced order system, including the multiplicative noise coefficients, are determined systematically via closed analytic formulae. These linear stochastic models succeed in forecasting the uncertainty and facilitate an extremely rapid data assimilation scheme. The new Lagrangian data assimilation is then applied to observations of sea ice floe trajectories that are driven by atmospheric winds and turbulent ocean currents. It is shown that observing only about 30 non-interacting floes in a 200 km × 200 km domain is sufficient to recover the key multi-scale features of the ocean currents.

Date:	February 23, 2022 (Wednesday)
Time:	10:00 – 11:00am (Hong Kong Time)
Venue:	ZOOM: https://hku.zoom.us/j/ Meeting ID: 913 6532 3891 Password: 310656

All are welcome