MMM SPECIAL SEMINAR

Particle filters for high-dimensional geophysical systems.

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The atmosphere is a highly nonlinear turbulent chaotic system, and understanding and predicting its behaviour is one of the largest scientific endeavours of our time. Data assimilation can play a fundamental role in both prediction and further understanding by systematically combining observations and model forecasts, and exploring their differences in a systematic way.

Many powerful data-assimilation methods have been developed, such as Ensemble Kalman Filters and 3D and 4Dvar. All these methods are based on linearisation, and shown to be very powerful for weakly nonlinear problems. However, many atmospheric data-assimilation problems, such as detailed cloud processes, high intensity storms and hurricanes, are highly nonlinear in nature, and are in need of data-assimilation methods that can handle stronger nonlinearities.

Particle filters hold the promise of fully nonlinear data-assimilation. They consist of an ensemble of model states or particles, like an Ensemble Kalman Filter, but the update by observations is not assuming linearity and does not rely on linearisations. Unfortunately, the vanilla particle filter would need trillions or more particles in high-dimensional systems like the atmosphere. This has been coined the curse of dimensionality.

Recently much progress has been made in trying to beat this curse by more clever particle filters. The efforts range from applying localisation in particle filters, a trick similar to that used in Ensemble Kalman Filters, to trying to move the particles in state space to optimal positions, either in one step or using iterative procedures. I will discuss these recent attempts and their pro's and con's. Furthermore, I will discuss our latest results using ideas from optimal transportation combined with machine learning techniques, and expand on potential future developments.

***Tuesday, 21 May 2019, 10:30 AM**
***Please note special day/time & location**
Refreshments 10:15 AM
NCAR-Foothills Laboratory, 3450 Mitchell Lane, **FL2-1001 Small Auditorium**

This seminar will be webcast live at:
http://ucarconnect.ucar.edu/live

Recorded seminar link can be viewed here:
https://www.mmm.ucar.edu/events/seminars