

## 2011 Special Program: Two-Phase Flow, Interface Flow and Related Phenomena

*Handling nonlinearity in the Ensemble Kalman Filter framework*

2011 - 11 - 23 (Wed.)

15:00 - 17:00

308, Mathematics Research Center Building (ori. New Math. Bldg.)

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The "Running-in-Place (RIP)" and "Quasi Outer-Loop (QOL)" methods are proposed to improve the ability of Ensemble Kalman Filter to handle the nonlinearity of the evolving dynamics that can take place in long assimilation windows. Using a no-cost EnKF smoother, the RIP algorithm aims to improve both the accuracy of the mean and "flow-dependent" error statistics carried in the ensemble perturbations. As a simplified version of RIP, QOL has the purpose of re-centering the ensemble perturbations around a more accurate ensemble mean.

The performance of the LETKF with the QOL and RIP methods is tested with the Lorenz 3-variable model. Results show that the use of the QOL allows the LETKF to use longer assimilation windows with significant improvement of the analysis accuracy during periods of highly nonlinear growth and the more expensive RIP can further improve the analysis accuracy. Both RIP and QOL achieve the accuracy that better than the 4D-Var using optimal long assimilation windows and the quasi-static variational analysis. Comparisons are also made with the Ensemble Randomized Maximum likelihood (EnRML) method, another iterative EnKF based on the Gauss-Newton minimization method. Results show that RIP robustly has its advantage over EnRML at the unstable locations of phase transitions or saddle points.

The RIP method has been successfully applied to several realistic frameworks. In this talk, several RIP applications will be presented.

