MS14: Multiscale Problems and Methods in Numerical Simulations

Multi-Scale Data Assimilation for Turbulent Systems

Yoonsang Lee, *New York University*

Data assimilation of turbulent signals is an important challenging problem because of the extremely complicated large dimension of the signals and incomplete partial noisy observation. We propose a suite of multi-scale data assimilation methods which use conditional Gaussians. The methods are tested on a six dimensional conceptual dynamical model for turbulence which mimics interesting features of anisotropic turbulence including two way coupling between the large and small scale parts, intermittencies, and extreme events.

A Methods for Multiscale Inverse Problems

Christina Frederick, *Georgia Institute of Technology*

I will discuss inverse problems involving elliptic partial differential equations with highly oscillating coefficients. The multiscale nature of such problems poses a challenge in both the mathematical formulation and the numerical modeling, which is hard even for forward computations. I will discuss uniqueness of the inverse in certain problem classes and show numerical model examples that can be applied to inverse problems in medical imaging and exploration seismology.

An Iterative Substructuring Method for Problems Posed in H(div)

Duk-soon Oh, *Rutgers University*

A BDDC(balancing domain decomposition method by constraints) algorithm, an iterative substructuring method, is defined by primal constraints, a weighted average across the interface between the subdomains, and local components given in terms of Schur complements of local subproblems. A BDDC for vector field problems discretized with Raviart-Thomas elements is introduced. Our method is based on a new type of weighted average and adaptive coarse space method to deal with highly varying coefficients.

A Multiscale Computation for Highly Oscillatory Dynamical Systems Using an EMD-Type Method

Seong Jun Kim, *Georgia Institute of Technology*

The heterogeneous multiscale method (HMM) is devised to compute the coarse scale behavior in a multiscale system without fully resolving the fine scale solutions. Using multi-grid type of coupling, at each coarse time step, the solver acquires the necessary information by resolving fine scale models. The Adaptive Local Iterative Filtering (ALIF) is a nonlinear signal analysis strategy which decomposes a signal into several intrinsic mode functions and extracts essential information. In this talk, I will propose a numerical method that combines HMM and ALIF to compute the slow dynamics for highly oscillatory dynamical systems.