MS6: Numerical Approximation of Partial Differential Equations I

Schródinger Equation with Fractional Laplacians

Yanzhi Zhang, *Missouri University of Science and Technology*

Recently, one debate in the literature is whether the fractional Schródinger equation in an infinite potential well has the same eigenfunctions as those of its standard (non-fractional) counterpart. Due to the nonlocality of the fractional Laplacian, it is challenging to find the eigenvalues and eigenfunctions of the fractional Schródinger equation analytically. In this talk, we numerically study the eigenfuctions of the fractional Schródinger equation.

A Meshfree Implicit Filter for Solving Nonlinear Filtering Problems

Feng Bao, *Oak Ridge National Laboratory*

We consider a nonlinear filtering problem where a signal process is modeled by a stochastic differential equation and the observation is perturbed by a white noise. The goal of nonlinear filtering is to find the best estimation of the signal process based on the observation. An implicit Bayesian filter was proposed to improve the long term and stable computation of particle filter. In this presentation, we shall present an algorithm to improve the efficiency of the implicit filter through the use of meshfree approximations to the solutions of nonlinear filtering problems.

An Indirect Spectral Method for Fractional Differential Equations

Hong Wang, *University of South Carolina*

Fractional differential equations (FDEs) provide an adequate description of anomalously diffusive transport processes. Recent study shows that FDEs with smooth coefficients may generate solutions with strongly local behavior and poor regularity. Consequently, a traditional spectral method need not generate high-order accuracy for FDEs with smooth coefficients. We present an indirect spectral method for a variable-coefficient FDE, which has a proved high-order accuracy as long as the problem has smooth coefficients. Numerical results are presented to show the utility of the method.

The Numerical Approximation of a Generalized Bio-Convection Flow

Song Chen, *University of Wisconsin at La Crosse*

Bio-convection occurs due to on average upward swimming micro-organisms. We will consider a generalized convective flow modeling the stationary and evolutionary behavior of the phenomenon. In this model, the viscosity is assumed to be dependent on concentration of the micro-organisms. The well posedness of the problem will be studied using Rothe's method. The numerical approximation of the solution will then be conducted using finite element method. At last I will show the computational result and compare it to the real experiment.