SIAM-SC CUHK Online Seminar Series

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Computational Multiscale Methods for Linear Poroelasticity with High Contrast

Dr. Simon, Sai-Mang Pun - Texas A&M University

In this talk, we present a computational multiscale method to solve the problem of linear heterogeneous poroelasticity with coefficients of high contrast. The proposed method makes use of the idea of energy minimization with suitable constraints in order to generate efficient basis functions for the displacement and the pressure. These basis functions are constructed by solving a class of local auxiliary optimization problems based on eigenfunctions containing local information on the heterogeneity. Techniques of oversampling are adapted to enhance the computational performance. Convergence of first order is shown and illustrated by numerical tests.

Neural network based policy iteration for stochastic games

Mr. Yufei Zhang - University of Oxford

In this work, we propose a class of numerical schemes for solving semilinear Hamilton-Jacobi-Bellman-Isaacs (HJBI) boundary value problems which arise naturally from exit time problems of diffusion processes with controlled drift. We exploit policy iteration to reduce the semilinear problem into a sequence of linear Dirichlet problems, which are subsequently approximated by a multilayer feedforward neural network ansatz. We establish that the numerical solutions converge globally in the H^2 -norm, and further demonstrate that this convergence is superlinear, by interpreting the algorithm as an inexact Newton iteration for the HJBI equation. Moreover, we construct the optimal feedback controls from the numerical value functions and deduce convergence. The numerical schemes and convergence results are then extended to oblique derivative boundary conditions. Numerical experiments on the stochastic Zermelo navigation problem and the perpetual American option pricing problems are presented to illustrate the theoretical results and to demonstrate the effectiveness of the method.