THE UNIVERSITY OF HONG KONG

Institute of Mathematical Research
Department of Mathematics

Numerical Analysis Seminar

Parameter-Robust Preconditioning for Stochastic Galerkin Mixed Finite Element Problems

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Abstract

Stochastic Galerkin (SG) approximation is a popular approach for performing forward uncertainty quantification (UQ) in PDE models with uncertain inputs. Unlike conventional sampling methods, such as Monte Carlo, SG schemes yield approximations which are functions (usually, polynomials) of the random input variables so that all realisations of the PDE solution are effectively approximated simultaneously. Since they use simple tensor product approximation spaces, standard SG schemes give rise to huge linear systems with coefficient matrices with a characteristic Kronecker product structure. The number of equations can easily run into the hundreds of millions, even for relatively simple physical models, meaning that the associated coefficient matrices cannot be assembled and stored when working on standard desktop computers. Tailored linear algebra tools are required.

If sparse matrix-vector products can be performed efficiently and enough memory is available to store vectors of the appropriate length, then standard iterative solvers can still be used. The key challenge is then to construct suitable preconditioners that are cheap to implement and robust with respect to the SG discretisation parameters, the physical model parameters, and the number of random inputs and their statistical properties. In this talk, we consider mixed formulations of linear elasticity and poroelasticity problems with uncertain inputs arising in engineering applications, and discuss how to design preconditioners that are robust in the incompressible limit.

Date: October 19, 2021 (Tuesday)
Time: 4:00 – 5:00pm (Hong Kong Time)
Venue: Room 210, Run Run Shaw Bldg., HKU
and
ZOOM: https://hku.zoom.us/j/
Meeting ID: 913 6532 3891
Password: 310656

Attendance limited
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All are welcome