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Colloquium

Discretisation of PDEs in Banach-space settings: Eliminating Gibbs phenomena and resolving non-Hilbert solutions

Professor Kris van der Zee
University of Nottingham, United Kingdom

Abstract: Is it possible to obtain near-best approximations to solutions of partial differential equations (PDEs) in a general Banach-space setting? Can this be done with guaranteed stability? I will address these questions by introducing the nonstandard, nonlinear Petrov-Galerkin (NPG) discretisation.

The NPG method is imperative for PDEs with rough data or nonsmooth solutions having discontinuities. Its theory generalises and extends Babuska's theory for the classical Petrov-Galerkin method, as well as recent theories for residual-minimisation methods such as the discontinuous Petrov-Galerkin method (due to Demkowicz and Gopalakrishnan) and residual minimisation in L^p (due to Guermond). Crucial in the formulation of the NPG method is the nonlinear duality map, which is the natural extension of the Riesz map. I will show the stability of the NPG method and prove its quasi-optimality by extending a classical projection identity due to Kato.

To illustrate the significance of the new discretization framework, I will consider its application to the advection-reaction PDE and the Laplacian. Two of the main benefits of moving to Banach-space settings will be highlighted:

1. The ability to eliminate the notorious Gibbs phenomena of numerical overshoots when the solution contains discontinuities.
2. The ability to approximate on certain graded meshes, rough non-Hilbert solutions that can not be handled by the standard method in Hilbert spaces.

This is joint work with Ignacio Muga from Pontificia Universidad Catolica de Valparaiso.

Date:	Friday 5 January 2018
Venue:	Rm 222, Lady Shaw Building, The Chinese University of Hong Kong, Shatin
Time:	3:00 p.m. – 4:00 p.m.

All are Welcome!