THE UNIVERSITY OF HONG KONG

Institute of Mathematical Research
Department of Mathematics

Numerical Analysis Seminar

Reduced-Order Models in Computational Science and Engineering: fundamentals and applications

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Abstract

We provide the state of the art of Reduced Order Methods (ROM) for parametric Partial Differential Equations (PDEs), and we focus on some perspectives in their current trends and developments, with a special interest in parametric problems arising in offline-online Computational Fluid Dynamics (CFD). Efficient parametrisations (random inputs, geometry, physics) are very important to be able to properly address an offline-online decoupling of the computational procedures and to allow competitive computational performances. Current ROM developments in CFD include: (i) a better use of stable high fidelity methods, considering also spectral element method and finite volume discretisations, to enhance the quality of the reduced model too, and allowing to incorporate some turbulent patterns and increasing the Reynolds number; (ii) more efficient sampling techniques to reduce the number of the basis functions, retained as snapshots, as well as the dimension of online systems; (iii) the improvements of the certification of accuracy based on residual based error bounds and of the stability factors, as well as the guarantee of the stability of the approximation with proper space enrichments. For nonlinear systems, also the investigation on bifurcations of parametric solutions are crucial and they may be obtained thanks to a reduced eigenvalue analysis of the linearised operator. All the previous aspects are quite relevant in CFD problems to focus on real time simulations for complex parametric industrial, environmental and biomedical flow problems, or even in a control flow setting with data assimilation and uncertainty quantification. Model flow problems will focus on few benchmarks, as well as on simple fluid-structure interaction problems and shape optimisation applied to some industrial problems of interest.

Date:	December 15, 2022 (Thursday)
Time:	5:00 – 6:00pm
Venue:	ZOOM: https://hku.zoom.us/j/ Meeting ID: 913 6532 3891 Password: 310656

All are welcome