2024 年模型降阶算法研讨会

会议通知

尊敬的专家:

为探讨和发挥计算数学在生物物理、材料科学等领域的重要作用，加强数学与交叉学科间的交流与合作，促进数学基础理论、算法及应用等方面的创新发展，2024 年“模型降阶算法研讨会”将于 2024 年 10 月 10 日至 12 日在上海大学宝山校区 G 楼 GJ303 会议室召开。现代表本次会议组委会诚挚的邀请您前来参会。

组织委员会:

纪丽洁、潘晓敏、秦晓雪、涂一辉

举办单位:

上海大学 理学院数学系

会议费用:

本次会议不收取注册费，提供会议餐，参会人员的住宿及差旅费等费用自理。

注册、住宿地点及研讨会地点:

注册和住宿：上海大学 北大门 乐乎新楼（上海市宝山区锦秋路 716 号）；

研讨会地点：宝山校区 G 楼 GJ303 会议室

会务组人员联系方式:

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上海大学理学院数学系

2024 年 10 月 7 日

2024 年模型降阶算法研讨会

会议手册

2024 年 10 月 10 日---- 2024 年 10 月 12 日

2024年10月10日 会议日程			
上午	注册		
13:00-17:00	讨论交流		
17:00-19:00	晚餐		

2024年10月11日 会议日程			
时间	题目	报告人	单位
11:00-12:00	Filtering inversion based on model reduction method for porous media models with random inputs	巴玉明	广东师范大学
12:00 -13:30	午餐		
13:30-14:30	Reduced basis methods for parameterized PDEs	廖奇峰	上海科技大学
14:30-15:30	Non-intrusive reduced-order model for time-dependent stochastic partial differential equations utilizing dynamic mode decomposition and polynomial chaos expansion	孙祥	中国海洋大学
15:30-17:00	自由讨论		
17:00-19:00	晚餐		

2024年10月12日 会议日程	
离会	

报告题目和摘要

报告 (1)
题目: Filtering inversion based on model reduction method for porous media models with random inputs
演讲人：巴玉明（广东技术师范大学）
摘要：The model inputs (parameters, source, domain geometry and system structure, et al.) in many practical systems are often unknown. We need to identify or estimate these inputs by partial and noisy observations to construct predictive models and calibrate the models. In this work, the filtering inversion methods are proposed to reduce the uncertainties. Ensemble-based filtering methods need to compute the forward problem repeatedly. When the forward model is computationally intensive, such as multiscale models, non-Gaussian model and anomalous diffusion models, the full order model would be computationally prohibitive. In order to significantly improve the simulation efficiency, seeking more efficient sampling from the posterior and building surrogates of the forward models. For this work, the generalized multiscale finite element method (GMsFEM), generalized polynomial chaos (gPC) and variable-separation method (VS) are used to construct the reduced order models. To mitigate the underestimation for the variance of the posterior often occurred in ensemble Kalman filters, we adopt the multi-stage updates. We present a few numerical examples to illustrate the performance of proposed filtering methods based on model reduction methods. These filtering methods are applied to parameter estimation and state forecast of time-dependent anomalous diffusion models and data assimilation problems.

报告 (2)
题目：Reduced basis methods for parameterized PDEs
演讲人：廖奇峰（上海科技大学）
摘要：Reduced basis methods are widely used for solving parameterized PDEs. The idea of reduced basis methods is to find low-rank structures in the discrete solutions of PDEs, and to build efficient basis functions using the low-rank structures for Galerkin projection. In this talk, we demonstrate several success applications of reduced basis methods in the area of uncertainty quantification. Especially, we find that the low-rank structures can be independent of the numerical schemes, but they are properties of the underlying PDEs.

This is joint work with Howard Elman, Guang Lin and Jinglai Li.

报告 (3)

题目：Non-intrusive reduced-order model for time-dependent stochastic partial differential equations utilizing dynamic mode decomposition and polynomial chaos expansion

演讲人： 孙祥，中国海洋大学

摘要：In this study, we present a novel non-intrusive reduced-order model (ROM) for solving time-dependent stochastic partial differential equations (SPDEs). Utilizing proper orthogonal decomposition (POD), we extract spatial modes from high-fidelity solutions. A dynamic mode decomposition (DMD) method is then applied to vertically stacked matrices of projection coefficients for future prediction of coefficient fields. Polynomial chaos expansion (PCE) is employed to construct a mapping from random parameter inputs to the DMD-predicted coefficient field. These lead to the POD-DMD-PCE method. The innovation lies in vertically stacking projection coefficients, ensuring time-dimensional consistency in the coefficient matrix for DMD, and facilitating parameter integration for PCE analysis. This method combines the model reduction of POD with the time extrapolation strengths of DMD, effectively recovering field solutions both within and beyond the training time interval. The efficiency and time extrapolation capabilities of the proposed method are validated through various nonlinear SPDEs. These include a reaction-diffusion equation with 19 parameters, a two-dimensional heat equation with two parameters, and a one-dimensional Burgers equation with three parameters.