BABAK MABOUDI AFKHAM

PERSONAL INFORMATION

Born on 22 March 1989

Nationality	Iranian
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INTERESTS

Research	Fast Numerical Solutions for Parametric Partial Differential Equations, via Model Order Reduction. Developing Structure-Preserving Model-Reduction Techniques for Hyperbolic Problems.
Applied Mathematics	Model Order Reduction, Approximation Theory, Uncertainty Quantification, Inverse Problems, Machine Learning.
Pure Mathematics	Differential Geometry, Symplectic Geometry, Statistics.
Computer Science	Distributed and Parallel systems.

EDUCATION

2014-present   Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne-Switzerland

Ph.D. in Computational Mathematics and Simulation Science
Advisor: Prof. Jan S. Hesthaven
Research topic: Structure-Preserving Model-Reduction

Abstract: Over the past decade, model order reduction has been successful in reducing the computational complexity of large scale and parametric elliptic and parabolic partial differential equations. Model order reduction of hyperbolic equation, however remains as a challenge. These problems are often derived from physical or geometrical symmetries, conservation laws and invariants. Such structures are lost over the course of conventional model reduction routines, e.g. proper orthogonal decomposition (POD), which often leads to unstable and qualitatively wrong solutions. In my thesis, we investigate an alternative model reduction approach to preserve the symplectic symmetry, an intrinsic structures of Hamiltonian systems. Unlike POD that constructs an orthonormal basis for the reduction space, this method constructs am orthogonal basis with respect to the pseudo inner product associated with Hamiltonian systems, known as the symplectic form. We show that the symplectic orthogonality provide a similar convergence rate as conventional orthogonal bases. Furthermore, we generalize the method to adopt to the norms and inner products most appropriate to the problem set up and discretizatoin. This allows the method to be applied on a wider range of discretization methods, especially the finite element methods. Moreover, we extend the method to consider dissipative systems: systems that are under the influence of dissipative forces but are Hamiltonian otherwise in the absence of such forces.

2017-2018   Massachusetts Institute of Technology (MIT), Cambridge-United States of America

Exchange Graduate Student in Aeronautics and Astronautics
Advisor: Prof. Karen Willcox
Research topic: Energy-Preserving Model-Reduction for Euler's Equation

2012-2014   Royal Institute of Technology (KTH), Stockholm-Sweden

M.Sc. in Scientific Computing
Advisor: Prof. Anna-Karin Tornberg
Thesis topic: Simulation of elastic rods with intrinsic curvature and twist immersed in fluid

2007-2012   Sharif University of Technology (SUT), Tehran-Iran

B.Sc. in Theoretical Mathematics
Advisor: Prof. Mohammad Reza Razvan
Thesis topic: Learning Spectral Clustering

AWARDS

2017   The SNSF Doc.Mobility grant, 2017.

2014   The SMC (Stockholm Mathematics Center) award for excellent master thesis, 2014.

2013   KTH scholarship and tuition fee waiver, 2013.

PUBLICATIONS

2018	Babak Maboudi Afkham, Jan S. Hesthaven, "Structure-Preserving Model-Reduction of Dissipative Hamiltonian System", Journal of Scientific Computing (2018): 1-19
2017	Babak Maboudi Afkham, Jan S. Hesthaven, "Structure-Preserving Model-Reduction of Parametric Hamiltonian System", SIAM Journal on Scientific Computing 39.6 (2017): A2616-A2644
2018	Babak Maboudi Afkham, Ashish Bhatt, Bernard Haasdonk, Jan S. Hesthaven, "Symplectic Model Reduction with a Weighted Inner Product", Submitted to SIAM Journal on Scientific Computing
2018	Babak Maboudi Afkham, Karen Willcox, Jan Hesthaven, "Energy Preserving Model Reduction of Fluid Flows" - Under Preparation

TEACHING AND SUPERVISION

2014-2017	Principal Teacher Assistant of Analysis I and II: Holding 8 hours of lecture, Holding Exercise classes,Designing weekly exercise sheets
2017	Co-supervisor of the master thesis: "Energy preserving model reduction of fluid dynamics", Nicolo Ripamonti
2015	Supervisor of the semester project: "Hamiltonian formulation for non-conservative systems", Bozorgmehr Aminian

INVITED TALKS AT INTERNATIONAL CONFERENCES AND WORKSHOPS

2018	MoRePaS 2018 Conference - Nantes, France Keynote: "Model Order Reduction While Preserving a First Integral"
2016	MORCIP - Workshop on Model Order Reduction for Control & Inverse Problems, EPFL Invited Speaker: "Structure-Preserving Model Reduction of Hamiltonian Systems"
2016	ALOP - Workshop on Reduced Order Models in Optimization, The University of Trier Invited Speaker: "Structure-Preserving Model Reduction of Hamiltonian Systems"

SCHOOLS AND WORKSHOPS

2016	Winter School on Uncertainty Quantification, University of Basel, Switzerland
2015	Bayesian Methods for Inverse Problems, University of Warwick, Uk.
2015	International School on Model Reduction for Dynamical Control Systems, Dubrovnik, Croatia.
2013	PDC Summer School: Introduction to High-Performance Computing, KTH, Stockholm, Sweden.

LANGUAGES

English (Professional working proficiency), Persian (Mother Tongue), French (Intermediate Proficiency)

HOBBIES

Rock-climbing, Mountaineering (Mount Kilimanjaro 5895m, Mount Damavand 5678m), Distance Running

REFERENCES

Prof. Jan S. Hesthaven
Ecole Polytechnique Fédérale de Lausanne (EPFL)

Prof. Bernard Haasdonk
University of Stuttgart

April 3, 2018