2021 AFOSR Computational Math Program Review

Dr. Fariba Fahroo | August 9-13, 2021 | Virtual

Agenda Day 1 | August 9, 2021
All times are EDT

Time	Topic	Speaker
9:30-9:45	**Zoom Login**	
9:45-10:00	**Welcome – Opening Remarks**	Dr. Fariba Fahroo, AFOSR
10:00	**(YIP)** Decision Oriented Learning of Dynamical Systems Under Uncertainty	Alex Gorodetsky (University of Michigan)
10:25	**MURI-** Prediction, Statistical Quantification and Mitigation of Extreme Events Caused by Exogenous Causes or Intrinsic Instabilities	Themis Sapsis (MIT)
11:10	**(YIP)** Learning the Solution Operator of Partial Differential Equations with Physics-Informed DeepOnets	Paris Perdikaris (University of Pennsylvania)
11:35	**BREAK**	
11:40	**(YIP)** Adaptive, Data-Driven Model Reduction for Shock-Dominated Flows to Enable Many-Query Computational Physics	Matt Zahr (University of Notre Dame)
12:05	**(YIP)** Context-Aware Learning for Multi-Fidelity Uncertainty Quantification	Benjamin Peherstorfer (Courant Institute, NYU)
12:30	**LUNCH**	
13:00	Efficient and Accurate Structure Preserving Schemes for Nonlinear Dissipative Systems	Jie Shen (Purdue University)
13:25	Enhanced Mesh Refinement for Multi-Dimensional Data	Jennifer Ryan (Colorado School of Mines)
13:50	Techniques to Quantify the Information Content of Models Employed for Adaptive Material Systems and Aerial Monitoring Strategies	Ralph Smith (NCSU)
14:15	Low-Rank Multi-Fidelity Algorithms, Model Selection, and Budget Allocation	Akil Narayan (University of Utah) Alireza Doostan (UC Boulder)
14:55	**BREAK**	
15:15	High-Order Strong Stability Preserving Multi-Derivative Implicit and IMEX Runge--Kutta Methods with Asymptotic Preserving Properties	Sigal Gottlieb (U Mass, Dartmouth)

Time	Topic	Speaker
15:40	Fast Running Decoders and CFD-Mesh based Neural Networks}	Daniel Reasor (AFRL/RW)
16:00	Machine Learning to Improve Turbulence Modeling	Chris Schrock (AFRL/RQ)
16:25	**MURI:** Machine Learning for Physics-based Systems: Optimal Approximations, Architectures, and Training	Karen Willcox (UT Austin)
17:10	Discussions On UQ, ROMs, ML	
18:00	**MEETING ADJOURN FOR THE DAY**	

Agenda Day 2 | August 10, 2020 **All times are EDT**		
Time	**Topic**	**Speaker**
9:30-9:45	**Zoom Login**	
9:45	A Bayesian Machine-Learning Perspective on the Quantum Many-Electron Problem	George Booth (King's College)
10:10	Information Methods for Uncertainty Quantification and Performance Guarantees in Predictive Modeling	Markos Katsoulakis, Luc Rey-Bellet (U Mass- Amherst), Paul Dupuis (Brown University)
10:50	Dealing With Noises in General Domains Using Spectral Approximations	Zhongqiang Zhang (WPI)
11:15	Information Geometry of Physics-Informed Statistical Manifolds and Its Use in Data Assimilation	Daniel Tartakovsky (Stanford University)
11:40	Damage Detection with Spectral Representations	Amanda Criner (AFRL/RXCA)
12:05	**LUNCH**	
12:40	Program Status Update	Fariba Fahroo (AFOSR)
13:00	Geometric Optimal Mass Transport: Engineering, Medicine, Physics	A. Tannenbaum (Stony Brook University), Tryphon Georgiou (UC Irvine)
13:30	Bias Mitigation of Face Recognition Models	Adam Oberman (McGill University), Stan Osher (UCLA)
13:55	Robust Invariant Domain Preserving Approximation of the Compressible Navier-Stokes equations with Tabulated Equation of State	Jean-Luc Guermond, Bojan Popov (TAMU)

Time	Topic	Speaker
14:20	{Multi-Resolution WENO Schemes, Limiters for Discontinuous Galerkin Methods, and Steady State Computation}	Chi-Wang Shu (Brown University)
14: 45	**BREAK**	
15:00	Solution-Based Mesh Adaptation for Large Eddy Simulation	ZJ Wang, Jeremey Ims (University of Kansas)
15:25	Operational Dynamical Modeling: New Physics Models and New Solvers	Denys Bondar (Tulane University)
15:50	**MURI**: Revolutionary Advances in Correlated Electron Materials: From Strongly Correlated Electrons to Large Scale DFT and Quantum Embedding	Garnet Chan (Caltech)
16:50	**Discussions**	
18:00	**MEETING ADJOURN FOR THE DAY**	

Agenda Day 3 | August 11, 2020 All times are EDT		
Time	**Topic**	**Speaker**
9:30-10:00	**Zoom Login**	
10:00	Implicit Multi-Scale Plasma Simulations Using Low Cost Matrix-Free Methods for Partial Differential Equations	Andrew Christlieb (Michigan State University)
10:25	A Low Rank Tensor Representation of Nonlinear Vlasov-Poisson and Vlasov-Maxwell Solutions	Jingmei Qiu (U. Delaware)
10:50	Simulation of High Power Optical Fiber Amplifiers	Leszek Demkowicz (UT Austin) Jay Gopalakrishnan (Portland State University)
11:30	AFRL/RX COE: Data-Driven Discovery of Optimized Multifunctional Material Systems (D3OM2S)	Elizabeth Holm (CMU)
12:00	**LUNCH**	
12:45	Fast Methods for the Boltzmann Equation	Aihua Wood (AFIT), Alex Aleseenko (CSU Northridge)

Time	Topic	Speaker
13:10	High Information Bandwidth Adaptive Hybrid Kinetic Simulation	Robert Martin (AFRL/RQRS)
13:35	Spectral Difference Method for Simulating Solar Dynamo	Chunlei Liang (Clarkson University)
14:00	Conditional Learning, Rare Events, and Extremes	Jose Blanchet (Stanford University), Youssef Marzouk (MIT)
14:45	**BREAK**	
15:00	Rank-Adaptive Tensor Methods for High-Dimensional Nonlinear PDEs	Daniele Venturi (UC Santa Cruz)
15:25	Games for Computation and Learning	Houman Owhadi (Caltech)
15:50	Data Driven Deep Learning of Unknown Partial Differential Equations	Dongbin Xiu (Ohio State University)
16:15	Future Directions Discussions	
18:00	**MEETING ADJOURN FOR THE DAY**	

Agenda Day 4 | August 12, 2020 All times are EDT		
Time	**Topic**	**Speaker**
9:30-9:45	**Zoom Login**	
9:45	Machine Learned Adaptive Modeling for Optimization of Complex Systems	Ed Forster, Phil Beran, Chris Schrock (AFRL/RQVC)
10:10	Koopman Mode Analysis of Spatially Extended Dynamical Systems with Applications to Agent-Based Models	Maria Fonoberova (AIMDyn Inc.)
10:35	Optimization Under Uncertainty - A Generalized Koopman Expectation Framework	Adam Gerlach (AFRL/RQQA)
11:00	New Computational Mathematics for next-generation Operations Research: From Warfare and Arms Races to Soft Power in Systems of Systems	Neil Johnson (GWU)
11:25	Learning in Multi-Scale Models with Stochastic Source Coupling	Guus Jacobs (SD State University)
11:50	**LUNCH**	
12:20	A Machine Learning Framework for High-Dimensional Mean Field Games and Optimal Control	Lars Ruthotto (Emory)

12:45	**MURI**: Innovations in Mean-Field Game Theory for Scalable Computation and Diverse Applications	Stan Osher (UCLA)
13:45	**MURI:** Learning and Meta-Learning of Partial Differential Equations via Physics-Informed Neural Networks: Theory, Algorithms, and Applications	George Karniadakis (Brown University)
14:45	**BREAK**	
15:00	PROM-Based Framework for MDAO Problems: Piecewise-Global Reduced-Order Bases, New Take on Active Subspaces, and Embedded Boundary Method for CFD with Smoothness	Charbel Farhat (Stanford University)
15:25	Multiscale Stochastic Modeling, Conditioning, and Simulation of Rare Events	Roger Ghanem (USC)
15:55	Dissipative Potentials for Anisotropic Heterogeneous Media	Oana Cazacu (UFL- REEF)
16:20	Scale-Bridging Generalized Finite Element Methods for Structural Dynamics and Wave Propagation	C. Armando Duarte
16:45	Mesh Generation and AI-enhanced Algorithms for Modeling Complex Materials Systems	Soheil Soghrati (Ohio State University)
17:05	**BREAK**	
17:10	Discussions	
18: 00	**MEETING ADJOURN FOR THE DAY**	

13 AUGUST 2021, FRIDAY

PROPULSION and POWER LIQUID ROCKET ENGINE RESEARCH PROGRAM

1)   10:00-10:15   Introduction to Propulsion and Power

2)   10:15-12:15   COE: Multi-Fidelity Modeling of Rocket Combustor Dynamics
KARTHIK DURAISAMY, THE UNIVERSITY OF MICHIGAN, (2 hours)

12:15-12:45   BREAK

3)   12:45-13:30   Dynamics of High Pressure Reacting Shear Flows
RAMAKANTH MUNIPALLI, Aerospace Systems Directorate (AFRL/RQR) EDWARDS AFB CA

4)   13:30-14:00   Detailed Simulation and Modeling of Turbulent Multiscalar Mixing and
                Combustion Processes at Supercritical Conditions
        VIGOR YANG, GEORGIA TECH RESEARCH CORPORATION

5)   14:00-14:30   Studies of Finite-Rate Effects Relevant to Modeling of Liquid-Propellant
                Rocket Combustion Instabilities
        ANTONIO SANCHEZ, UNIVERSITY OF CALIFORNIA, SAN DIEGO

14:30-15:00   BREAK

6)   15:00-15:30   Exploration of Acoustically Coupled Combustion Instabilities Relevant to
                Rocket Propulsion Systems
        ANN KARAGOZIAN, UNIVERSITY OF CALIFORNIA LOS ANGELES

7)   15:30-16:00   High-Pressure LPRE Combustion Dynamics: Low-Cost Computation and
                Stochastic Analysis
        WILLIAM SIRIGNANO, UNIVERSITY OF CALIFORNIA IRVINE

8)   16:00-16:30   High-pressure Chemistry, Transport and Flame Dynamics in LRE
Combustion Instability
CHUNG K. LAW, PRINCETON UNIVERSITY