



# 2020 AFOSR Computational Math Program Annual Review

Dr. Fariba Fahroo | August 10-14, 2020 | Virtual

## Agenda Day 1 | August 10, 2020

All times are EDT

Time	Topic	Speaker
9:30-10:00	Zoom Login	
10:00	Welcome	Col Jason Mello, AFOSR/RT Chief Dr. Fariba Fahroo, AFOSR
10:20	(YIP) Extracting Models with Theoretical Guarantees for Data-Driven Discovery of Dynamical Systems(YIP) Extracting Models with Theoretical Guarantees for Data-Driven	Hayden Schaeffer (CMU)
10:45	(YIP) Learning with Arbitrary Tensor Networks	Alex Gorodetsky (University of Michigan)
11:10	(YIP) When and Why PINNs Fail to Train: A Neural Tangent Kernel Perspective	Paris Perdikaris (University of Pennsylvania)
11:30	BREAK	
11:45	(YIP) Data-Infused Fractional PDE Modelling and Simulation: from Uncertainty Quantification to Uncertainty Qualification	Mohsen Zayernouri (Michigan State University)
12:10	(YIP) Operational Dynamical Modelling: Driven Imposters	Denys Bondar (Tulane University)
12:35	LUNCH	
13:00	(YIP) Active Sampling Methods for Bayesian Learning and Rare Event Statistics	Antoine Blanchard Themis Sapsis (MIT)
13:25	Unconditionally Energy stable SAV Schemes for Gradient Systems With Global Constraints	Jie Shen (Purdue University)
13:45	More Accurate Multi-scale Higher Order Methods for Under-resolved Simulations	Jennifer Ryan (Colorado School of Mines)
14:05	Robust and Scalable Multi-Fidelity Algorithms for Model-Based Predictions	Akil Narayan (University of Utah) Alireza Doostan (UC Boulder)
14:30	BREAK	
15:10	New Lab Projects	Chris Schrock (AFRL/RQ) Amanda Criner (AFRL/RX) Daniel Reasor (AFRL/RW)
15:45	MURI: A Unified Mathematical and Algorithmic Framework for Managing Multiple Information Sources of Multi- physics Systems	Karen Willcox ( UT Austin)

<b>16:30</b>	Discussions On UQ, ROMs, ML	
<b>18:00</b>	<b>MEETING ADJOURN FOR THE DAY</b>	

<b>Agenda Day 2   August 11, 2020</b> <b>All times are EDT</b>		
<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
<b>9:30-10:00</b>	<b>Zoom Login</b>	
<b>10:00</b>	A Data-Driven Approach to Correlated Quantum Many-Body Problems	George Booth (King's College)
<b>10:25</b>	Transfer of Quantum Information Between Scales	Brian Swingle (University of Maryland, College Park)
<b>10:50</b>	Structure-Preserving Reduced Order Models	Jan Hesthaven (EPFL)
<b>11:15</b>	Information Divergences, Mass Transport Metrics and Their Interpolations for Enhanced Learning	Markos Katsoulakis, Luc Rey-Bellet (U Mass- Amherst), Paul Dupuis (Brown University)
<b>11:50</b>	<b>LUNCH</b>	
<b>12:40</b>	Program Status Update	Fariba Fahroo (AFOSR)
<b>13:00</b>	Using Continuum Limits To Understand Data Clustering And Classification	Franca Hoffmann, Andrew Stuart (Caltech)
<b>13:25</b>	Games for Computation and Learning: Do ideas have shape? Idea Formation is the Continuous Limit of Artificial Neural Networks}	Houman Owhadi (Caltech)
<b>13:50</b>	Efficient Numerical Methods for Stochastic Equations in Irregular and Moving Domains	Zhongqiang Zhang (WPI)
<b>14:15</b>	Data Driven Governing Equation Recovery using Deep Neural Networks	Dongbin Xiu (Ohio State University)
<b>14: 40</b>	<b>BREAK</b>	
<b>15:10</b>	Deep Learning for Multiscale Computing	Nathan Kutz (University of Washington)
<b>15:35</b>	Progress on Inverse Lax-Wendroff Procedure for Numerical Boundary Conditions	Chi-Wang Shu (Brown University)

<b>16:00</b>	<b>MURI:</b> Progress in the Quantum Many-Body Description of Strongly Correlated and Complex Materials	Garnet Cheng (Caltech)
<b>16:45</b>	<b>Discussions</b> – Denys Bondar	
<b>18:00</b>	<b>MEETING ADJOURN FOR THE DAY</b>	

<b>Agenda Day 3   August 12, 2020</b> <b>All times are EDT</b>		
<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
<b>9:30-10:00</b>	<b>Zoom Login</b>	
<b>10:00</b>	Advances in O(N) Implicit Wave Solvers for Modeling Magnetrons	Andrew Christlieb (Michigan State University)
<b>10:25</b>	Eulerian Lagrangian Discontinuous Galerkin Method for Nonlinear Vlasov Dynamics	Jingmei Qiu (U. Delaware)
<b>10:50</b>	Computational Mathematics of Fiber Laser Amplifiers	Jacob Grosek (AFRL/RD)
<b>11:15</b>	Simulation of High Power Optical Fiber Amplifiers	Leszek Demkowicz (UT Austin) Jay Gopalakrishnan (Portland)
<b>11:40</b>	Optimal Mass Transport: Biology, Engineering, Physics	A. Tannenbaum (Stony Brook University), Tryphon Georgiou (UC Irvine)
<b>12:05</b>	<b>LUNCH</b>	
<b>12:45</b>	Fast Methods for the Boltzmann Equation	Aihua Wood (AFIT), Alex Aleseenko (CSU Northridge)
<b>13:10</b>	High Information Bandwidth Adaptive Hybrid Kinetic Simulation	Robert Martin (AFRL/RQRS)
<b>13:35</b>	SSP Two-derivative Error Inhibiting Schemes with Post-processing	Sigal Gottlieb (U Mass, Dartmouth)
<b>14:00</b>	Positive Asymptotic Preserving Approximation of the Radiation Transport Equation	Jean-Luc Guermond, Bojan Popov (TAMU)
<b>14:25</b>	<b>BREAK</b>	

<b>14:25-16:15</b>	<p align="center"><b>New Directions in Computational Math (10 minute presentations)</b></p> <p align="center">Karthik Duraisamy Jean-Luc Guermond Chi-Wang Shu Jingmei Qiu Andrew Christlieb</p>	
<b>16:15</b>	<b>BREAK</b>	
<b>16:20</b>	Tensor-structured Techniques for Large-scale Electronic-Structure Calculations	Vikram Gavini (University of Michigan)
<b>16:45</b>	Learning on Dynamic Manifolds	Daniel Tartakovsky (Stanford University)
<b>17:10</b>	Dynamic Tensor Approximation of High-dimensional Nonlinear PDEs	Daniele Venturi (UC Santa Cruz)
<b>17:35</b>	Discussions	
<b>18:00</b>	<b>MEETING ADJOURN FOR THE DAY</b>	

<b>Agenda Day 4   August 13, 2020</b> <b>All times are EDT</b>		
<b>Time</b>	<b>Topic</b>	<b>Speaker</b>
<b>9:30-10:00</b>	<b>Zoom Login</b>	
<b>10:00</b>	Radial Basis Functions for Numerical Simulation	Benjamin Akers (AFIT)
<b>10:25</b>	Adaptive Multi-Fidelity Methods for Physics-Based Decision-Making	Chris Schrock, Phil Beran, Ed Forster (AFRL/RQVC)
<b>10:50</b>	Koopman Mode Analysis of Spatially Extended Dynamical Systems with Applications to Agent-Based Models	Maria Fonoberova (AIMDyn Inc.)
<b>11:15</b>	Accelerated Stochastic Gradient Descent Algorithms	Adam Oberman (McGill University), Stan Osher (UCLA)
<b>11:40</b>	Beyond Noise: How Generative Models can Strengthen Computational Mathematics in Situations with Complex Noise Processes and Extremes	Neil Johnson (GWU)

<b>12:00</b>	<b>LUNCH</b>	
<b>12:45</b>	<b>MURI</b> – Innovations in Mean-Field Game Theory for Scalable Computation and Diverse Applications	Stan Osher (UCLA)
<b>13:45</b>	<b>MURI:</b> Learning and Meta-Learning of Partial Differential Equations via Physics-Informed Neural Networks: Theory, Algorithms, and Applications	George Karniadakis (Brown University)
<b>14:10</b>	Multi-Physics Models with Stochastic Forcing	Guus Jacobs (SD State University)
<b>14:35</b>	New Approach for Modeling Ductile Damage	Oana Cazacu (UFL- REEF)
<b>15:00</b>	<b>BREAK</b>	
<b>15:25</b>	An Integrated Computational Framework for Modeling Materials with Complex and Evolving Microstructures	Soheil Soghrati (Ohio State University)
<b>15:50</b>	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)
<b>16:15</b>	Advances in Optimal Experimental Design for Bayesian Inverse Problems	O. Ghattas (UTA), Y. Marzouk (MIT)
<b>16:50</b>	<b>BREAK</b>	
<b>17:00</b>	Interscale Turbulence-Chemistry Dynamics with Reduced Basis Representations for Application to LES Modeling	Jim Brasseur (UC Boulder), Yuan Xuan (Penn State University)
<b>17:20</b>	Implicit Discontinuous Galerkin Methods for Simulating Turbulent Flows at High Reynolds Number On Graphics Processors	J. Peraire, N. C. Nguyen (MIT)
<b>17:40</b>	Discussions on CFD for High Speed Flow	
<b>18: 30</b>	<b>MEETING ADJOURN FOR THE DAY</b>	