



University of Groningen

Model Reduction of Synchronized Lur'e Networks

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At-A-Glance

SIAM Conference on Computational Science



February 25-March 1, 2019 Spokane Convention Center Spokane, Washington, U.S.

Sponsored by the SIAM Activity Group on Computational Science and Engineering (CSE)



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Society for Industrial and Applied Mathematics 3600 Market Street, 6th Floor Philadelphia, PA 19104-2688 U.S. Telephone: +1-215-382-9800 Fax: +1-215-386-7999 Conference E-mail: meetings@siam.org Conference Web: www.siam.org/meetings/ Membership and Customer Service: (800) 447-7426 (U.S. & Canada) or +1-215-382-9800 (worldwide) *https://www.siam.org/conferences/CM/Main/cse19*

Monday, February 25

Sunday, February 24

..... 3:00 p.m. - 7:30 p.m. Registration Ballroom Fover

3:45 p.m. - 4:45 p.m. Broader Engagement (BE): Welcome and Orientation 302A

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4:45 p.m. - 5:45 p.m. Student Days: Student Orientation **Conference** Theater

5:45 p.m 7:45 p.m.	9
Welcome Reception	Ì
Ballroom Foyer	Ś

Monday, February 25

7:00 a.m. - 8:15 a.m Data Science Book Series Editorial Board Meeting Davenport Hotel -- Meeting Room 11

. 7:30 a.m. - 4:00 p.m. Registration Ballroom Foyer

..... 8:15 a.m. - 8:30 a.m Welcome Remarks Ballroom 100BC

8:30 a.m. - 9:15 a.m. **IP1** Modelling 100 Percent Renewable Electricity Michael C. Ferris, University of Wisconsin, Madison, U.S. Ballroom 100BC

9:15 a.m. - 9:45 a.m Coffee Break Ballroom Foyer



9:45 a.m. - 11:25 a.m. **Concurrent Sessions** MS1 Mathematical Advances in Deep Learning - Part I of II Ballroom 100BC MS2 Scientific Software: Practices, Concerns, and Solution Strategies - Part I of II **Conference** Theater

MS3 AWM Workshop: Data Science and Mathematics - Part I of II 102A MS4 Student Days: Student Chapter Presentations - Part I of II 102BMS5 Recent Advances in Modeling and Numerical Analysis for Electronic Structure Calculations - Part I of II 102C MS6 Roundoff Error in High-Performance Implementations of CG/Lanczos-type Solvers - Part I of II 102D MS7 Numerical Linear Algebra for Machine Learning - Part I of II 111A MS8 Uncertainty Quantification and Data Assimilation - Part I of II 111BMS9 Avoiding Big-data: In-situ Visualisation and Analysis for Large-scale CFD Simulations - Part I of II 111C MS10 Model Reduction, Adaptivity, and High Dimensionality in Uncertainty **Ouantification - Part I of II** 300A MS11 Data Enabled Modeling and Discovery in Science and Engineering - Part I of II 300B MS12 Task-based Programming for Scientific Computing: Runtime Support -Part I of II 300C MS13 BE: Mentor Protégé 300D MS14 Emerging Trends for Structure Preserving Model Order Reduction - Part I of II 302B MS15 Fast Methods for High-Frequency Wave Propagation - Part I of II 303A MS16 Tutorials for Students: Accessible Introductions to Active Research Areas 303B MS17 Advances in Phase Retrieval: Theory and Applications - Part I of II 201B MS18 Computational and Numerical Methods in Electronics - Part I of II 201C

Monday, February 25

MS19 Fast Solvers for Inverse Problems with PDEs - Part I of II 202A MS20 Moment Methods in Kinetic Theory -Part I of II 202BMS21 Recent Advances in High Order Lagrangian/ALE Methods - Part I of II 202C MS22 Use of C++ in Computational Science Libraries and Applications - Part I of II 203 MS23 Finite Element Methods on Unfitted Meshes - Part I of II 205 MS24 Applications of the AMReX Block Structured Adaptive Mesh Refinement Framework - Part I of II 206A MS25 Discovering and Exploiting Lowdimensional Structures in Computational Models - Part I of II 206B MS26 Parallel-in-Time Integration Techniques - Part I of II 206C MS27 Modeling, Analyzing and Computing of Fractional Partial Differential Equations -Part I of II 206D MS28 FASTMath Tools and Technologies -Part I of II 207 MS29 Computational Methods for Kinetic Models of Plasma - Part I of II 401A MS30 Graph and Combinatorial Algorithms for Enabling Exascale Applications - Part I of II 401BMS31 Numerical Methods for Earth System Modeling - Part I of II 401C MS32 Recent Advances in Error Estimation for Complex Problems - Part I of II 402A MS33 Recent Progresses in Data Analysis -Part I of II 402BMS34 Methods for Large-scale Risk-averse Optimization - Part I of II 402C CP1 Modeling and Uncertainty Quantification I 301

Monday, February 25

Monday, February 25

CP2 Computational Fluid Mechanics I 201A

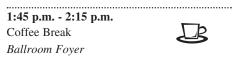
..... 11:30 a.m. - 12:30 p.m. **Concurrent Sessions**

PD1 Future Directions of Research Funding Programs 111A PD2 Early Career Panel **Conference** Theater

11:30 a.m. - 1:00 p.m. Lunch Break Attendees on their own

Fundamental Algorithms Book Series Editorial Board Meeting Davenport Hotel -- Meeting Room 11

1:00 p.m. - 1:45 p.m. IP2 Deep Learning for Inverse Problems -Some Recent Approaches Carola-Bibiane Schönlieb, University of Cambridge, United Kingdom Ballroom 100BC





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..... 2:15 p.m. - 3:55 p.m. **Concurrent Sessions** MS35 Mathematical Advances in Deep Learning - Part II of II Ballroom 100BC MS36 Scientific Software: Practices, Concerns, and Solution Strategies - Part II of II Conference Theater MS37 AWM Workshop: Data Science and Mathematics - Part II of II 102A MS39 Recent Advances in Modeling and Numerical Analysis for Electronic Structure Calculations - Part II of II 102CMS40 Roundoff Error in High-Performance Implementations of CG/Lanczos-type Solvers - Part II of II 102D MS41 Numerical Linear Algebra for Machine Learning - Part II of II 111A

MS42 Uncertainty Quantification and Data Assimilation - Part II of II 111BMS43 Avoiding Big-data: In-situ Visualisation and Analysis for Large-scale CFD Simulations - Part II of II 111C MS44 Model Reduction, Adaptivity, and High Dimensionality in Uncertainty Quantification - Part II of II 300A MS45 Data Enabled Modeling and Discovery in Science and Engineering - Part II of II 300B MS46 Task-based Programming for Scientific Computing: Runtime Support - Part II of II 300C MS47 Advances in Computational Methods for Data Assimilation - Part I of II 300D MS48 BE: Best Practices for CSE Diversity and Inclusion 302A MS49 Emerging Trends for Structure Preserving Model Order Reduction - Part II of II 302B MS50 Fast Methods for High-Frequency Wave Propagation - Part II of II 303A MS51 Tutorials for Students: Accessible Introductions to Active Research Areas - Part II of II 303B MS52 Advances in Phase Retrieval: Theory and Applications - Part II of II 201B MS53 Computational and Numerical Methods in Electronics - Part II of II 201CMS54 Fast Solvers for Inverse Problems with PDEs - Part II of II 202A MS55 Moment Methods in Kinetic Theory -Part II of II 202BMS56 Recent Advances in High Order Lagrangian/ALE Methods - Part II of II 202CMS57 Use of C++ in Computational Science Libraries and Applications - Part II of II 203 MS58 Finite Element Methods on Unfitted Meshes - Part II of II

Monday, February 25

MS59 Applications of the AMReX Block Structured Adaptive Mesh Refinement Framework - Part II of II 206A MS60 Discovering and Exploiting Lowdimensional Structures in Computational Models - Part II of II 206B MS61 Parallel-in-Time Integration Techniques - Part II of II 206C MS62 Modeling, Analyzing and Computing of Fractional Partial Differential Equations -Part II of II 206D MS63 FASTMath Tools and Technologies -Part II of II 207 MS64 Computational Methods for Kinetic Models of Plasma - Part II of II 401A MS65 Graph and Combinatorial Algorithms for Enabling Exascale Applications - Part II of II 401B MS66 Numerical Methods for Earth System Modeling - Part II of II 401C MS67 Recent Advances in Error Estimation for Complex Problems - Part II of II 402A MS68 Recent Progresses in Data Analysis -Part II of II 402B MS69 Methods for Large-scale Risk-averse Optimization - Part II of II 402C CP3 Modeling and Uncertainty Quantification Π 201A **CP4** Fluid-Structure Interactions 301

. 3:55 p.m. - 4:10 p.m. Intermission

4:10 p.m. - 5:50 p.m. **Concurrent Sessions** MS70 Machine Learning in Computational Science Ballroom 100BC MS71 Scientific Machine Learning **Conference** Theater

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Monday, February 25	Monday, February 25	Tuesday, February 26
MS72 Recent Progress in Coordinate-wise	MS90 Spectral Deferred Correction Methods	7:00 a.m 8:15 a.m.
Descent Methods	for Temporal Integration	Student Days: Chapter Breakfast with SIAM
102A	205	Leadership (by invitation)
MS73 Student Days: Student Chapter Presentations - Part II of II	MS91 Large-scale PDE-Constrained Optimization Algorithms and Applications	Davenport Hotel –Cedar Ballroom
102B	206A	Math in Industry Book Committee Meeting
MS74 Transmission Eigenvalue Spectrum for Electromagnetic and Elastic Scatterers	MS92 Latest Advances in Viscoplastic CFD: Discretisation, Simulation and Applications	Davenport Hotel Meeting Room 11
102C	206B	7:30 a.m 4:00 p.m.
MS75 Unfitted Discretization Methods - Part I of II	MS93 Nonlinear Reduced Order Modeling of Realistic Engineering Fluid Flows	Registration Ballroom Foyer
102D	206C	
MS76 Multigrid Solvers for Partially	MS94 Asynchronous Iterative Methods	8:30 a.m 9:15 a.m.
Structured Meshes and for Advanced Architectures	206D	IP3 Reduced Order Methods for PDEs: State
111A	MS95 Performance Portability and Numerical	of the Art and Perspectives with Applications
MS77 Multirate Time Stepping Methods	Libraries: Challenges and Opportunities for Sustainable Science - Part I of II	in Industry, Medicine and Environmental
111B	207	Sciences
MS78 Optimization with Coupled PDEs in	MS96 Computationally Efficient Derivative-	Gianluigi Rozza, SISSA, International School for Advanced Studies, Trieste, Italy
Multiphysics Applications	Free Local and Global Optimization	Ballroom 100BC
111C	401A	Ballroom 100BC
MS79 Recent Developments in Numerical	MS97 Computational Challenges in the ECP	9:15 a.m 9:45 a.m.
Methods for PDEs and their Applications -	Energy Applications	Coffee Break
Part I of II	401B	Ballroom Foyer
300A	MS98 Computational Advances for Large-	Buttoom Foyer
MS80 Applications of Tensor	scale Geophysical Data	9:45 a.m 11:25 a.m.
Decompositions	401C	Concurrent Sessions
300B	MS99 Distributed-Memory Graph Analytics:	MT1 Introduction To PETSc
MS81 A Posteriori Error Estimation for Various Adaptive Finite Element Methods	Programming Models, Algorithms and Applications	300D
300C	402A	MS102 Scalable Optimization: Paradigms, Tools, and Applications - Part I of II
MS82 BE: Lightning Talks	MS100 Scalable Adaptive Applications:	Ballroom 100BC
300D	Recent Developments	MS103 Recent Advances in Multirate Time
MS83 Adjoints of Nonlinear Dynamics in	402B	Integration for Multiphysics Problems
CFD Applications	MS101 Scientific Data Visualization	Conference Theater
302A	Platforms Facilitating New Paradigms	MS104 Accelerating Electronic Structure
MS84 Advances and Applications of	402C	Calculations with GPUs - Part I of II
Numerical Methods for Free Boundaries	CP5 Data Science Applications	102A
302B	201A	MS105 Computational Challenges at the
MS85 Developments in Algebraic Multigrid	CP6 Computational Fluid Mechanics II	Frontiers of Numerical Relativity - Part I of II
for Nonsymmetric and Hyperbolic Problems	201C	102B
303A	())	MS106 Computational Scalability and
MS86 Hardware-aware Algorithms and Numerics for Heterogeneous Supercomputers	6:00 p.m 7:15 p.m.	Complex Geometry in Integral Equation
303B	PD3 Strategies for Promoting Diversity and Inclusion within our Profession	Methods - Part I of II
MS87 Advances in Computational Methods	Conference Theater	102C
for Data Assimilation - Part II of II	Conjerence Ineuer	MS107 Unfitted Discretization Methods - Part
201B	7:30 p.m 9:30 p.m.	II of II
MS88 Performance Portability through	SINUM Editorial Board Meeting	102D MS108 Physics Motivated Problems in
Source-to-source Code Transformations	Davenport Hotel Meeting Room 10	MS108 Physics Motivated Problems in Machine Learning - Part I of II
202B		111A
MS89 Recent Advances in Accurate and		MS109 Physics/Chemistry-aware Machine
Verified Numerical Computations		Learning - Part I of II

111B

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Tuesday, February 26

Tuesday, February 26

MS126 Data Assimilation and Optimization

MS110 Recent Advances in Machine Learning and Data-driven Methods for Physical Sciences - Part I of II 111C MS111 Scalable Parallel Multigrid Solvers -Part I of II 300A MS112 Recent Advances in Model Reduction and Uncertainty Quantification - Part I of II 300B MS113 Recent Advances in Computational Methods for High Dimensional Bayesian Inversion - Part I of II 300C MS114 BE: Broader Engagement Technical Research - Part I of II 302A MS115 BE: Securing Extreme-Scale Scientific Computing 302B MS116 Advances in Unstructured Mesh Algorithms and their Applications - Part I of Π 303A MS117 Batched BLAS: API Standardization, Libraries, and Applications - Part I of II 303B MS118 Hydrodynamics at Small Scales: Fluctuating Hydrodynamics - Part I of II 201B MS119 Model Reduction for Problems with Strong Convection, Sharp Gradients, and Discontinuities - Part I of II 201CMS120 Structure Preserving Techniques for Hyperbolic Systems - Part I of II 202A MS121 Theoretical and Computational Advancements in Ice-Sheet Modeling - Part I of II 202B MS122 High-order Solvers for Wave Problems - Part I of II 202C MS123 Application of Fractional Calculus in Material Science and Engineering - Part I of II 203 MS124 Multiphysics Simulation with MOOSE - Part I of II 205 MS125 Computational Tools and Precision Medicine 206A

in Physiologic Modeling - Part I of II 206B MS127 Design and Usability of Highperformance PDE Software Engines and Frameworks - Part I of II 206C MS128 Exascale Applications with High-Order Methods - Part I of II 206D MS129 Performance Portability and Numerical Libraries: Challenges and Opportunities for Sustainable Science - Part II of II 207 MS130 Computational Engineering (BGCE) Student Paper Prize - Part I of II 401A MS131 Homogenization and Reduced Order Modelling for Wave Equations - Part I of II 401B MS132 Latest Advances in Topology and Shape Optimization - Part I of II 401C MS133 Quantitative Image Analysis - Part I of II 402A MS134 Reproducibility in Network Algorithms - Part I of II 402B MS135 WCD Workshop - 1 of 4 402C **CP7** Multilevel Methods 301 CP8 Computational Electromagnetics 201A 9:45 a.m. - 11:45 a.m. Career Fair Ballroom 100A

11:30 a.m. - 12:30 p.m. Concurrent Sessions PD4 Mentor-Mentee Mixer 111A PD5 Mid-Career Panel Conference Theater

11:30 a.m. - 1:00 p.m. Lunch Break Attendees on their own

CSE Editorial Board Meeting Davenport Hotel -- Meeting Room 11

Tuesday, February 26

1:00 p.m. - 1:45 p.m.

IP4 Fluid-Structure Interaction in Medicine and Biology: Methods, Models, and Applications Boyce E. Griffith, *University of North Carolina at Chapel Hill, U.S. Ballroom 100BC*

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1:45 p.m. - 2:15 p.m. Coffee Break *Ballroom Foyer*



2:00 p.m. - 4:00 p.m. Career Fair Ballroom A

2:15 p.m. - 3:55 p.m. **Concurrent Sessions** MS136 Scalable Optimization: Paradigms, Tools, and Applications - Part II of II Ballroom 100BC MS137 Toward Software Ecosystems for Computational Science and Engineering *Conference Theater* MS138 Accelerating Electronic Structure Calculations with GPUs - Part II of II 102A MS139 Computational Challenges at the Frontiers of Numerical Relativity - Part II of Π 102BMS140 Computational Scalability and Complex Geometry in Integral Equation Methods - Part II of II 102C MS141 Physics Motivated Problems in Machine Learning - Part II of II 111A MS142 Physics/Chemistry-aware Machine Learning - Part II of II 111BMS143 Recent Advances in Machine Learning and Data-driven Methods for Physical Sciences - Part II of II 111C MS144 Scalable Parallel Multigrid Solvers -Part II of II 300A MS145 Recent Advances in Model Reduction and Uncertainty Quantification - Part II of II 300B MS146 Recent Advances in Computational Methods for High Dimensional Bayesian Inversion - Part II of II 300C

Tuesday, February 26	Tuesday, February 26	Wednesday, February 27
MS147 AWM Workshop Panel: Perspectives and Advice from Women in Research <i>300D</i> MS148 BE: Broader Engagement Technical Research - Part II of II <i>302A</i>	 MS164 Computational Engineering (BGCE) Student Paper Prize - Part II of II 401A MS165 Homogenization and Reduced Order Modelling for Wave Equations - Part II of II 401B 	7:00 a.m. – 8:15 a.m. Book Committee Meeting Davenport Hotel Meeting Room 11 MAC Committee Meeting Davenport Hotel Meeting Room 12
MS149 BE: Social Modeling through Game Design, A STEAM Workshop 302B MS150 Advances in Unstructured Mesh Algorithms and their Applications - Part II of II 303A	 MS166 Latest Advances in Topology and Shape Optimization - Part II of II 401C MS167 Quantitative Image Analysis - Part II of II 402A 	8:00 a.m 4:00 p.m. Registration Ballroom Foyer 8:30 a.m 9:15 a.m. IP5 Communication Avoiding: The Past
MS151 Batched BLAS: API Standardization, Libraries, and Applications - Part II of II <i>303B</i>	MS168 Reproducibility in Network Algorithms - Part II of II 402B MS169 WCD Workshop - 2 of 4	Decade and the New Challenges Laura Grigori, <i>Inria Paris, France</i> Ballroom 100BC
MS152 Hydrodynamics at Small Scales: Fluctuating Hydrodynamics - Part II of II 201B MS153 Model Reduction for Problems with Strong Convection, Sharp Gradients, and	402C CP9 Numerical Linear Algebra I 102D CP10 Mathematical Optimization I 201A	9:15 a.m 9:45 a.m. Coffee Break Ballroom Foyer
Discontinuities - Part II of II 201C MS154 Structure Preserving Techniques for Hyperbolic Systems - Part II of II 202A	3:55 p.m 4:10 p.m. Intermission	 9:45 a.m 11:25 a.m. Concurrent Sessions MT2 Solving Differential Equations with the libMesh Finite Element Library 300D
MS155 Theoretical and Computational Advancements in Ice-Sheet Modeling - Part II of II 202B	4:10 p.m 4:50 p.m. Poster Blitz Ballroom 100BC	MS170 Exploiting Model Hierarchies, Sparsity and Low-Rank Structure of Large- scale Bayesian Computation - Part I of II <i>Ballroom 100BC</i>
MS156 High-order Solvers for Wave Problems - Part II of II 202C	4:50 p.m 6:50 p.m. PP1 General Posters PP101 Minisymposterium: AWM Workshop PP102 Minisymposterium: Broader	MS171 Progress and Challenges in Extreme Scale Computing and Data - Part I of II <i>Conference Theater</i>
MS157 Application of Fractional Calculus in Material Science and Engineering - Part II of II 203 MS158 Multiphysics Simulation with MOOSE - Part II of II	Engagement PP103 Minisymposterium: Software Productivity and Sustainability for CSE and Data Science <i>Riverside Hall D</i>	 MS172 Advanced HPC Trends for Oil and Gas Applications - Part I of II <i>102A</i> MS173 Student Days: Undergraduate Presentations <i>102B</i>
205 MS159 Data Assimilation in Fluid Models 206A MS160 Data Assimilation and Optimization in Physiologic Modeling - Part II of II	6:30 p.m 8:00 p.m.	MS174 Advances and Applications in Numerical Methods for Interfacial Flows - Part I of II <i>102C</i> MS175 Numerical Methods for Multi-
206B MS161 Design and Usability of High- performance PDE Software Engines and Frameworks - Part II of II 206C	7:00 p.m 8:00 p.m. PD6 Thinking of Writing a Book? Conference Theater Reception Follows Panel	Material Fluid Flows - Part I of II <i>102D</i> MS176 Machine Learning Strategies for Computer Simulation of Physical Systems - Part I of II
MS162 Exascale Applications with High- Order Methods - Part II of II 206D MS163 Advances In Nonlinearly Stable Methods	7:30 p.m 9:30 p.m. SISC Editorial Board Meeting Davenport Hotel Meeting Room 10	 <i>IIIA</i> MS177 Machine Learning Approaches for the Sciences and Engineering: Recent Developments - Part I of II <i>IIIB</i>

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Wednesday, February 27 Wednesday, February 27 Wednesday, February 27

MS178 Recent Advances in Multilevel Solvers - Part I of II 111CMS179 High-order Finite Element Methods for Complex and Multiphysics Applications -Part I of II 300A MS180 Multiphysics and Multiscale Problems in Computational Science and Engineering - Part I of II 300B MS181 Novel Computational Algorithms for Future Computing Platforms - Part I of II 300C MS182 GPU Accelerated Computing on Summit 301 MS183 Mathematical Methods for Control and Optimization of Large-Scale Energy Networks - Part I of II 302A MS184 Entropy-stable Formulations for Numerical Solution of Conservation Laws -Part I of II 302B MS185 High-order PDE Methods on CPU Architectures with Wide SIMD Units - Part I of II 303A MS186 Advances in Analyzing Floating-point Errors in Computational Science - Part I of II 303B MS187 Computational Methods for Linear Kinetic Transport Equations - Part I of II 201BMS188 Reduced Order Modeling for Parametric CFD Problems- Part I of II 201C MS189 Advances in Quasi-Monte Carlo Methods - Part I of II 202B MS190 Fast and Accurate Integral Methods for Highly Oscillatory Phenomena - Part I of Π 202C MS191 New Challenges and Opportunities for Model Order Reduction - Part I of II 203 MS192 Computational Strategies for Highdimensional Data Assimilation and Bayesian Inverse Problems - Part I of II 205 MS193 Data-driven Methods in Fluid

Dynamics - Part I of II

206A

MS194 Efficient Solvers for Coupled Multiphysics Problems - Part I of II 206B MS195 CSE Education and Workforce - Part I of II 206CMS196 Recent Developments of Numerical Methods for Hyperbolic and Parabolic Equations - Part I of II 206D MS197 Task-based Programming for Scientific Computing: Linear Algebra Applications - Part I of II 207 MS198 Surrogate Modeling and Data Compression for Exascale Applications - Part I of II 401A MS199 Recent Developments in Theory and Implementation of Subspace Correction Methods 401B MS200 Sparse Function Approximations: Theory and Applications - Part I of II 401C MS201 Theoretical and Computational Aspects in Nonlocal and Material Science Modeling - Part I of II 402A MS202 Nonlocal Models in Computational Science and Engineering - Part I of II 402B MS203 Generalizable Machine Learning and Clustering Methods: Applications in Bias, Biology, and Imaging 402C CP11 Numerical Linear Algebra II 201A **CP12** Mathematical Optimization II 202A 11:30 a.m. - 12:00 p.m. SP1 SIAG CSE Best Paper Prize Lecture Ballroom 100BC 11:30 a.m. - 1:00 p.m. SIAM Workshop Celebrating Diversity and Broader Engagement Joint Lunch (by invitation)

Davenport Hotel -- Cedar Ballroom

12:00 p.m. - 1:00 p.m. Lunch Break Attendees on their own

1:00 p.m. - 1:45 p.m.

IP6 Stochastic Gradient Descent, in Theory and Practice Rachel Ward, *University of Texas at Austin, U.S. Ballroom 100BC*

1:45 p.m. - 2:15 p.m. Coffee Break *Ballroom Foyer*



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2:15 p.m. - 3:55 p.m. Concurrent Sessions

MS204 Exploiting Model Hierarchies, Sparsity and Low-rank Structure of Largescale Bayesian Computation - Part II of II *Ballroom 100BC* MS205 Progress and Challenges in Extreme

Scale Computing and Data - Part II of II Conference Theater

MS206 Advanced HPC Trends for Oil and Gas Applications - Part II of II *102A*

MS207 Advances and Applications in Numerical Methods for Interfacial Flows -Part II of II

102C

MS208 Numerical Methods for Multi-Material Fluid Flows - Part II of II 102D

MS209 Machine Learning Strategies for Computer Simulation of Physical Systems -Part II of II

111A

MS210 Machine Learning Approaches for the Sciences and Engineering: Recent Developments - Part II of II 111B

MS211 Recent Advances in Multilevel Solvers - Part II of II

111C

MS212 High-order Finite Element Methods for Complex and Multiphysics Applications -Part II of II

300A

MS213 Multiphysics and Multiscale Problems in Computational Science and Engineering - Part II of II *300B*

MS214 Tensor-based Methods for Scientific and Engineering Computing 300C

MS215 BE: Parallel Algorithm Design *301*

Wednesday, February 27 Wednesday, February 27 Thursday, February 28

and Optimization of Large-scale Energy Networks - Part II of II 302A MS217 Entropy-stable Formulations for Numerical Solution of Conservation Laws -Part II of II 302B MS218 Novel Computational Algorithms for Future Computing Platforms - Part II of II 303A MS219 Advances in Analyzing Floating-point Errors in Computational Science - Part II of II 303B MS220 Computational Methods for Linear Kinetic Transport Equations - Part II of II 201BMS221 Reduced Order Modeling for Parametric CFD Problems - Part II of II 201C MS222 High-order PDE Methods on CPU Architectures with Wide SIMD Units - Part II of II 202A MS223 Advances in Quasi-Monte Carlo Methods - Part II of II 202BMS224 Fast and Accurate Integral Methods for Highly Oscillatory Phenomena - Part II of II 202CMS225 New Challenges and Opportunities for Model Order Reduction - Part II of II 203 MS226 Computational Strategies for Highdimensional Data Assimilation and Bayesian Inverse Problems - Part II of II 205 MS227 Data-driven Methods in Fluid Dynamics - Part II of II 206A MS228 Efficient Solvers for Coupled Multiphysics Problems - Part II of II 206B MS229 CSE Education and Workforce - Part II of II 206C MS230 Recent Developments of Numerical Methods for Hyperbolic and Parabolic Equations - Part II of II 206D MS231 Task-based Programming for Scientific Computing: Linear Algebra Applications - Part II of II 207

MS216 Mathematical Methods for Control

MS232 Surrogate Modeling and Data Compression for Exascale Applications - Part II of II 401A MS233 Recent Developments in Numerical Methods for PDEs and their Applications -Part II of II 401B MS234 Sparse Function Approximations: Theory and Applications - Part II of II 401C MS235 Data Science and Analytics in Industry 402A MS236 Nonlocal Models in Computational Science and Engineering - Part II of II 402BMS237 WCD Workshop - 4 of 4 402C**CP13** Numerical PDEs IV 201A 3:55 p.m. - 4:10 p.m.

Intermission

4:10 p.m. - 4:50 p.m.

Poster Blitz Ballroom 100BC

4:50 p.m. - 6:50 p.m.

Ð **PP2** General Posters 7/FN PP201 Minisymposterium: AMReX: Software and Applications PP202 Minisymposterium: Clawpack and ForestClaw Software PP203 Minisymposterium: Multi-level and Multi-fidelity Monte Carlo Methods for Uncertainty Quantification PP204 Minisymposterium: Student Days -Student Chapter Posters PP205 Minisymposterium: Student Days -Undergraduate Posters

Riverside Hall D

..... 7:00 p.m. - 8:00 p.m. **Business Meeting**

Ballroom 100BC



Complimentary beer and wine will be served.

7:45 a.m. - 4:30 p.m. Registration Ballroom Foyer

8:00 a.m. - 8:15 a.m.

Awards Announcement Ballroom 100BC



8:15 a.m. - 8:45 a.m.

SP2 SIAG/CSE Early Career Prize: Data-Driven Discovery and Control of Complex Systems: Uncovering Interpretable and Generalizable Nonlinear Models Steven Brunton, University of Washington, U.S.Ballroom 100BC

8:45 a.m. - 9:15 a.m.

SP3 SIAM/ACM Prize in Computational Science and Engineering The Singular Value Decomposition: Anatomy of an Algorithm, Optimizing for Performance Jack J. Dongarra, University of Tennessee and

Oak Ridge National Laboratory, U.S. Ballroom 100BC

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9:15 a.m. - 9:45 a.m. Coffee Break Ballroom Foyer



9:45 a.m. - 11:25 a.m. **Concurrent Sessions** MT3 MOOSE: Enabling Multiphysics 300D MS238 Theory and Application of Surrogate Models for Bayesian Inverse Problems - Part I of II

Ballroom 100BC

MS239 Multiphysics: Extensible, Composable Algorithms and Software - Part I of II

Conference Theater

MS240 Boundary Integral Methods for Particulate Flows - Part I of II

102A

MS241 Close Evaluation of Layer Potentials: Advanced Numerical Methods and Applications

102B

MS242 Recent Advances in Models and Numerical Methods for Multiphase Problems - Part I of II 102C



Thursday, February 28

Thursday, February 28

MS243 Reduced Order Models for Fluids: Achievements and Open Problems - Part I of II

102D

MS244 Theory and Algorithms for Improved Performance of Machine Learning in Scientific Applications - Part I of II 111A

MS245 Models with Superior Reasons for Complex Big Data - Part I of II 111B

MS246 Machine Learning Methods in Computational Fluid Dynamics - Part I of II 111C

MS247 Recent Advances in PDE-constrained Optimization under Uncertainty - Part I of II *300A*

MS248 High Performance Sparse Matrix, Tensor, and Graph Kernels - Part I of II 300B

MS249 Tensor Based Methods in Scientific Computing and Data Science - Part I of II *300C*

MS250 BE: Advances in Computational Drug Discovery - Part I of II

302A

MS251 Algorithms and Software for Nonlinear Eigenvalue Problems - Part I of II *302B*

MS252 Preconditioning for High-order Matrix-free PDE Operators - Part I of II 303A

MS253 Mitigating Communication Costs Using Variable Precision Computing Techniques - Part I of II 303B

MS254 Mori-Zwanzig Formulation, Implementation and Applications - Part I of II 201C

MS255 Underwater Sensing and Signal Processing - Part I of II

202A

MS256 Industrial Eigensolution Technology: Advances and Challenges - Part I of II 202B

MS257 Towards Digital Twins for Industrial Applications - Part I of II 202C

MS258 Showcase of Research Supported by the DOE Computational Science Graduate Fellowship - Part I of II 203

MS259 Advances in Scalable Iterative, Multigrid and Direct Sparse Linear Solvers 205 **MS260** Applications of Data Assimilation in Science, Engineering, and Industry - Part I of II

206A

MS261 Computational Advances and Challenges in Data-enabled Life Sciences 206B

MS262 Modelling with Fractional PDEs: Statistical and Numerical Analysis - Part I of II

206C

MS263 Multi-scale Modeling and Computation of Complex and Active Fluids -Part I of II

206D

MS264 Exascale Software for High-order Methods - Part I of II

207

MS265 Dynamics with Inherent Noise: Stochastic Modelling and Simulation - Part I of II

401A

MS266 Inverse Problems in Medical Imaging - Part I of II

401B
MS267 Model Reduction and Reduced-order
Modeling of Dynamical Systems - Part I of II
401C
MS268 Novel Approaches for Design and

Analysis of Chaotic Dynamical Systems -Part I of II

402A

MS269 Resilience for Large Scale CSE Applications - Part I of II

402B

MS270 State-of-the-art high-order Numerical Methods and Complex Fluid Simulations -Part I of II 402C

CP14 Time Integration Methods

201A

CP15 Applications in CSE 201B

11:30 a.m. - 12:00 p.m.

SP4 James H. Wilkinson Prize for Numerical Software Prize Lecture: Solving the Two Language Problem in Scientific Computing and Machine Learning with Julia Jeffrey Bezanson, Stefan Karpinski, and Viral

Shah, Julia Computing, Inc., U.S. Ballroom 100BC

Thursday, February 28

12:00 p.m. - 1:00 p.m. Lunch Break Attendees on their own

1:00 p.m. - 1:45 p.m.

IP7 Physical, Numerical, and Computational Challenges in Modelling Oceans for Climate Alistair Adcroft, *Princeton University and NOAA-GFDL*, U.S. Ballroom 100BC

1:45 p.m. - 2:15 p.m. Coffee Break *Ballroom Foyer*



2:15 p.m. - 3:55 p.m. Concurrent Sessions

MS271 Theory and Application of Surrogate Models for Bayesian Inverse Problems - Part II of II

Ballroom 100BC

MS272 Multiphysics: Extensible, Composable Algorithms and Software - Part II of II

Conference Theater

MS273 Boundary Integral Methods for Particulate Flows - Part II of II 102A

MS274 Industrial Eigensolution Technology: Advances and Challenges - Part II of II *102B*

MS275 Recent Advances in Models and Numerical Methods for Multiphase Problems - Part II of II

102C

MS276 Reduced Order Models for Fluids: Achievements and Open Problems - Part II of II

102D

MS277 Theory and Algorithms for Improved Performance of Machine Learning in Scientific Applications - Part II of II 111A

MS278 Models with Superior Reasons for Complex Big Data - Part II of II 111B

MS279 Machine Learning Methods in Computational Fluid Dynamics - Part II of II 111C

MS280 Recent Advances in PDE-constrained Optimization under Uncertainty- Part II of II *300A*

MS281 High Performance Sparse Matrix, Tensor, and Graph Kernels - Part II of II *300B*

Thursday, February 28

Thursday, February 28

MS282 Tensor Based Methods in Scientific Computing and Data Science - Part II of II 300C MS283 BE: Advances in Computational Drug Discovery - Part II of II 302A MS284 Algorithms and Software for Nonlinear Eigenvalue Problems - Part II of II 302B MS285 Preconditioning for High-order Matrix-free PDE Operators - Part II of II 303A MS286 Mitigating Communication Costs Using Variable Precision Computing Techniques - Part II of II 303B MS287 Advances in Rare Event Simulation for Complex Dynamical Systems - Part I of II 201B MS288 Mori-Zwanzig Formulation, Implementation and Applications - Part II of Π 201C MS289 Underwater Sensing and Signal Processing - Part II of II 202A MS290 Scalable Solvers for the Helmholtz Problem - Part I of II 202B MS291 Towards Digital Twins for Industrial Applications - Part II of II 202CMS292 Showcase of Research Supported by the DOE Computational Science Graduate Fellowship - Part II of II 203MS293 Partitioned and Adaptive Methods for Initial Value Problems - Part I of II 205 MS294 Applications of Data Assimilation in Science, Engineering, and Industry - Part II of II 206A MS295 Statistical Applications of Continuous and Discrete Transport - Part I of II 206B MS296 Modelling with Fractional PDEs: Statistical and Numerical Analysis - Part II of II 206C MS297 Multi-scale Modeling and Computation of Complex and Active Fluids -Part II of II 206D

MS298 Exascale Software for High-order Methods - Part II of II 207MS299 Dynamics with Inherent Noise: Stochastic Modelling and Simulation - Part II of II 401A MS300 Inverse Problems in Medical Imaging - Part II of II 401B MS301 Model Reduction and Reduced-order Modeling of Dynamical Systems - Part II of Π 401C MS302 Novel Approaches for Design and Analysis of Chaotic Dynamical Systems -Part II of II 402A MS303 Resilience for Large Scale CSE Applications - Part II of II 402B MS304 State-of-the-art High-order Numerical Methods and Complex Fluid Simulations -Part II of II 402C **CP16** Numerical PDEs I 301 CP17 Computational Science Methods and Software 201A 3:55 p.m. - 4:10 p.m. Intermission 4:10 p.m. - 5:50 p.m. **Concurrent Sessions** MS305 Computing Tensor Decompositions Ballroom 100BC MS306 Performance Portability of Scientific **HPC** Applications Conference Theater MS307 Technology Transfer Using the Opensource Platform SU2 102A MS308 Data-driven and Mathematical Model Reductions for Combustion System Simulation and Design 102B MS309 Machine Learning for Inverse Problems and its Applications 111A

MS310 The Intersection of Graph Algorithms and Machine Learning *111B*

Thursday, February 28

MS311 Applications of Machine Learning in Fluid Mechanics 111CMS312 Optimization Under Uncertainty Using Multifidelity and Derivative-free Approaches 300A MS313 Parallel Numerical Linear Algebra for Future Extreme-scale Systems 300B MS314 Optimal Experimental Design for **Bayesian Inverse Problems** 300C MS315 Numerical Methods and Regularization for Ill-posed and Illconditioned Problems 300D MS316 Rational Approximation and its Applications 302A MS317 BE: Overcoming Workplace Challenges Panel: Trials, Tribulations, and Triumphs 302B MS318 Large-scale Particulate Flows: Towards Multi-scale Modeling from µm to km 303A MS319 Efficient Computational Methods for Molecular Dynamics 303B MS320 Advances in Rare Event Simulation for Complex Dynamical Systems - Part II of Π 201B MS321 Fast Algorithms for Integral Equations and Their Applications 202A MS322 Scalable Solvers for the Helmholtz Problem - Part II of II 202B MS323 Novel Adaptation, Decomposition and Expansion Algorithms for a Class of Large Scale Models 202C MS324 Flat Low-rank Matrix Formats: Potential and Limitations 203 MS325 Partitioned and Adaptive Methods for Initial Value Problems - Part II of II 205 MS326 High-order Accurate Numerical Methods for Fluid-structure Interaction Problems 206A

Thursday, February 28

Friday, March 1

MS327 Statistical Applications of Continuous and Discrete Transport - Part II of II 206B MS328 Integrated Mathematical and Computational Approaches to Interface Models and Data in Systems Biomedicine 206C MS329 Recent Advances in Discontinuous Galerkin Methods for Partial Differential Equations 206D MS330 Wave-based Imaging Meets Machine Learning 207 MS331 Recent Innovations in Restarting and Recycling Krylov Methods 401A MS332 SIMD Approaches for Achieving Performance and Portability on Emerging **Computational Architectures** 401B MS333 Theoretical and Computational Aspects in Nonlocal and Material Science Modeling - Part II of II 401C MS334 Using Structure for Scalable Optimization 402A MS335 Black-box Optimization for Autotuning 402BMS336 High-performance Graph Algorithms 402CCP18 Numerical PDEs II 102C

Friday, March 1

8:00 a.m. - 12:00 p.m. Registration *Ballroom Foyer*

8:30 a.m. - 9:15 a.m. IP8 Role of Tensors in Machine Learning Anima Anandkumar, *Amazon and California* Institute of Technology, U.S. Ballroom 100BC

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9:15 a.m. - 9:45 a.m. Coffee Break *Ballroom Foyer*



..... 9:45 a.m. - 11:25 a.m. **Concurrent Sessions** MT4 Firedrake: Automated High Performance Finite Element Simulation 300D MS337 Tensor Decomposition for High Performance Data Analytics - Part I of II Ballroom 100BC MS338 Software Productivity and Sustainability for CSE and Data Science -Part I of II Conference Theater MS339 Recent Development of Numerical Methods for Optics and Plasmonics - Part I of II 102A MS340 Neutrino Transport Methods in Astrophysics - Part I of II 102B MS341 Stochastic Modeling and Algorithms for Complex Physical Systems - Part I of II 102C MS342 Low Mach Number AMR Combustion Simulations with PeleLM - Part I of II 102D MS343 Data-augmented Reduced-order Modeling: Operator Learning and Closure/ error Modeling - Part I of II 111A MS344 Inverse Problems in Machine Learning - Part I of II 111B MS345 Optimal Experimental Design for Inverse Problems - Part I of II 111C MS346 Derivative-free and Global Optimization - Part I of II 300A MS347 Advances in Global Sensitivity Analysis with Applications to Complex Systems - Part I of II 300B MS348 Guidance from Early Applications of Quantum Computers 300C MS349 BE: Wrap-up Session 302A MS350 Multiscale and Domain Decomposition Approaches for PDEs with Rough Coefficients - Part I of II 302B

Friday, March 1

MS351 Recent Advances in Numerical Methods for Multiphase Flow Problems - Part I of II 303A MS352 Recent Developments in Model Order Reduction Methods - Part I of II 303B MS353 Mathematics of Energy Materials -Part I of II 201C MS354 Next Generation FFT Algorithms in Theory and Practice: Parallel Implementations, Sparse FFTs, and Applications - Part I of II 202A MS355 High-order Discretizations and Quadrature for Integral Equation Methods -Part I of II 202BMS356 Modeling Resource Utilization and Contention in HPC System-Application Interactions - Part I of II 202C MS357 Divide and Conquer Strategies for Large-scale Eigenvalue Problems - Part I of II 203 MS358 Advances in Multi-method Time Discretizations of Evolutionary PDEs - Part I of II 205 MS359 Computational Methods for Data Assimilation and Uncertainty Quantification - Part I of II 206A MS360 Numerical Methods for Biological Fluid Dynamics - Part I of II 206B MS361 Structure-exploiting Techniques for Approximation, Inference and Control of Complex Systems - Part I of II 206C MS362 Structured Matrix Methods - Part I of II 206D MS363 Summation-by-Parts: A Framework for the Development and Analysis of Modern Numerical Methods - Part I of II 207 MS364 Bringing Algorithms and New Applications to Novel Architectures - Part I of II 401A

Friday, March 1

Friday, March 1

MS365 High-order Discontinuous Galerkin and Finite Element Methods for CFD - Part I of II

401B

MS366 Hybrid Parallelization for Modern Architectures - Part I of II 401C

MS367 State-of-the-Art Auto-tuning: New Approaches and Algorithmic Innovations Towards Exascale Computing - Part I of II 402A

MS368 Meshfree Methods: Computational Advances and Applications - Part I of II *402B*

MS369 Molecular and Electronic Structure Theory Meets Data Science - Part I of II 402C

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CP19 Machine Learning in CSE 301

CP20 Numerical PDEs III 201B

. 11:25 a.m. - 11:30 a.m. Intermission

11:30 a.m. - 1:10 p.m. **Concurrent Sessions**

MS370 Tensor Decomposition for High Performance Data Analytics - Part II of II Ballroom 100BC

MS371 Software Productivity and Sustainability for CSE and Data Science -Part II of II

Conference Theater

MS372 Recent Development of Numerical Methods for Optics and Plasmonics - Part II of II

102A

MS373 Neutrino Transport Methods in Astrophysics - Part II of II

102B

MS374 Stochastic Modeling and Algorithms for Complex Physical Systems - Part II of II 102C

MS375 Low Mach Number AMR Combustion Simulations with PeleLM - Part II of II

102D

MS376 Data-augmented Reduced-order Modeling: Operator Learning and Closure/ error Modeling - Part II of II

111A

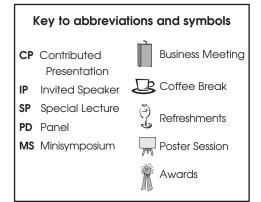
MS377 Inverse Problems in Machine Learning - Part II of II 111B

MS378 Optimal Experimental Design for Inverse Problems - Part II of II 111CMS379 Derivative-free and Global Optimization - Part II of II 300A MS380 Advances in Global Sensitivity Analysis with Applications to Complex Systems - Part II of II 300B MS381 Quantum Computing for **Computational Science Applications** 300C MS382 Multiscale and Domain Decomposition Approaches for PDEs with Rough Coefficients - Part II of II 302B MS383 Recent Advances in Numerical Methods for Multiphase Flow Problems - Part II of II 303A MS384 Recent Developments in Model Order Reduction Methods - Part II of II 303B MS385 Mathematics of Energy Materials -Part II of II 201CMS386 Next Generation FFT Algorithms in Theory and Practice: Parallel Implementations, Sparse FFTs, and Applications - Part II of II 202A MS387 High-order Discretizations and Quadrature for Integral Equation Methods -Part II of II 202B MS388 Modeling Resource Utilization and Contention in HPC System-application Interactions - Part II of II 202CMS389 Divide and Conquer Strategies for Large-scale Eigenvalue Problems - Part II of Π 203 MS390 Advances in Multi-method Time Discretizations of Evolutionary PDEs - Part II of II 205 MS391 Computational Methods for Data Assimilation and Uncertainty Quantification -Part II of II 206A

MS392 Numerical Methods for Biological Fluid Dynamics - Part II of II 206B

Friday, March 1

MS393 Structure-exploiting Techniques for Approximation, Inference and Control of Complex Systems - Part II of II 206C MS394 Structured Matrix Methods - Part II of II 206D MS395 Summation-by-Parts: A Framework for the Development and Analysis of Modern Numerical Methods - Part II of II 207 MS396 Bringing Algorithms and New Applications to Novel Architectures - Part II of II 401A MS397 High-order Discontinuous Galerkin and Finite Element Methods for CFD - Part II of II 401B MS398 Hybrid Parallelization for Modern Architectures - Part II of II 401CMS399 State-of-the-Art Auto-tuning: New Approaches and Algorithmic Innovations Towards Exascale Computing - Part II of II 402A MS400 Meshfree Methods: Computational Advances and Applications - Part II of II 402B MS401 Molecular and Electronic Structure Theory Meets Data Science - Part II of II 402C**CP21** Computational Mechanics 301



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