Eric J. Parish

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My research focuses on the development of engineering technologies that enable rapid simulation of complex multiscale and multiphysics systems through computational engineering, applied math, and machine learning.

Experience

- **Sandia National Laboratories** — Livermore, CA
  John von Neumann Postdoctoral Fellow — *Aug 2018 - Present*
- **University of Michigan** — Ann Arbor, MI
  Ph.D. Student — *Sept 2014 - June 2018*
- **Center for Turbulence Research** — Stanford, CA
  Summer researcher — *June 2016 - July 2016*
- **Air Force Research Laboratory** — Dayton, OH
  Summer researcher — *June 2015 - Sept 2015*
- **Los Alamos National Laboratory** — Los Alamos, NM
  Computational Physics Student Summer Workshop Student — *June 2014 - Aug 2014*
- **University of Wyoming** — Laramie, WY
  Undergraduate Research Assistant — *June 2013 - Aug 2013*

Education

- **University of Michigan** — Ann Arbor, MI
  Ph.D. in Aerospace Engineering — *Sept. 2014 – May 2018*
  Advisor: Karthik Duraismay
- **University of Wyoming** — Laramie, Wyoming
  Bachelor of Science in Mechanical Engineering, NCAA D1 Scholar-Athlete — *Aug. 2009 – May. 2014*

Funding

- **Multiscale Modeling, High-Order Methods, and Data-Driven Modeling** — 2018 - 2020
  Total: \$200K – \$100K *(2018),* \$100K *(2019)*
  - **Funding Source**: Sandia National Laboratories Laboratory-Directed Research & Development

Publications

- **Google Scholar Statistics (Oct. 2019)**:
  Citations: 262
  h-index: 7
  i10-index: 5

- **Preprints**:

1. Parish, E.J., and Carlberg, K. "Windowed least-squares model-reduction of dynamical systems" *Journal of Computational Physics*, Under Review, 2019.

2. Parish, E.J., and Carlberg, K. "Time-series machine-learning error models for approximate solutions to parameterized dynamical systems" *Computer Methods in Applied Mechanics and Engineering*, Under Review, 2019.
3. Parish, E.J., Wentland, C., and Duraisamy, K. "The Adjoint Petrov–Galerkin Method for Non-linear Model Reduction" *Computer Methods in Applied Mechanics and Engineering*, Under Review, 2019.
4. Parish, E.J., and Duraisamy, K., "Mori-Zwanzig and the Variational Multiscale Method: A Unified Framework for Multiscale Modeling" *arXiv preprint*, 2017.

- **Peer Reviewed Publications**:

1. Parish, E.J. and Duraisamy, K., "A Dynamic Subgrid Model for Large Eddy Simulations Based on the Mori-Zwanzig Formalism," *Journal of Computational Physics*, Vol. 349, pp. 154-175, 2017.
2. Gouasmi, A., Parish, E.J., and Duraisamy, K., "A priori estimation of memory effects in reduced-order models of nonlinear systems using the Mori-Zwanzig formalism," *Proc. Roy. Soc. A*, Vol 473, 2017.
3. Parish, E.J. and Duraisamy, K., "Non-Markovian closure models for Large Eddy Simulations based on the Mori-Zwanzig formalism," *Phy. Rev. Fluids*, Vol. 2, No. 1, 2017.
4. Parish, E.J., Duraisamy, K., and Chandrashekar, P. "Generalized Riemann problem-based upwind scheme for the vorticity transport equations," *Computers and Fluids*, Vol. 132, No. 25, pg. 10-18, 2016.
5. Parish, E.J. and Duraisamy, K.. "A Paradigm for data-driven predictive modeling using field inversion and machine learning," *Journal of Computational Physics*, Vol. 305, No. 15, 2015.
   Second most cited paper in the Journal of Computational Physics since 2016.

- **Conference Papers**:

1. Parish, E.J. and Duraisamy, K., "A dynamic subgrid scale model for LES based on the Mori-Zwanzig formalism," *Center for Turbulence Research Proceedings of the Summer Program*, 2016.
2. Parish, E.J. and Duraisamy, K., "Reduced Order Modeling of Turbulent Flows Using Statistical Coarse-graining," AIAA Aviation and Aeronautics Forum and Exposition, 2016.
3. Parish, E.J. and Duraisamy, K., "Quantification of Turbulence Modeling Uncertainties Using Full Field Inversion," AIAA Aviation and Aeronautics Forum and Exposition, 2015.

- **Invited Presentations**:

1. Parish, E.J., and Carlberg, K. "Windowed Least-Squares Reduced-Order Models for Dynamical Systems," SIAM UQ, Munich, Germany, 2020.
2. Parish, E.J., and Carlberg, K. "Time-series Machine Learning Error Models for Approximate Solutions to Dynamical Systems," 15th U.S. National Congress on Computational Mechanics, Austin, TX, 2019.
3. Parish, E.J. "Data-informed Closure Models with Memory Effects," Department of Applied Math Seminar, Virginia Polytechnic Institute and State University, Blacksburg, VA, 2019.
4. Parish, E.J. "Data-informed Reduced-Order Models with Memory Effects," SIAM Computational Science and Engineering, Spokane, WA, 2019.
5. Parish, E.J., "Machine Learning Closure Modeling for Reduced-Order Models of Dynamical Systems," Bay Area Scientific Computing Day, Livermore, CA., 2018.
6. Parish, E.J., Wentland, C., and Duraisamy, K., "Quantifying Unresolved Effects in Reduced Order Models using the Mori-Zwanzig Formalism and Variational Multiscale Method," SIAM UQ, Orange County, CA, 2018.
7. Parish, E.J. and Duraisamy, K., "Statistical Mechanics-Based Closures for Galerkin ROMs," 14th U.S. National Congress on Computational Mechanics, Montreal, Canada, 2017.
8. Parish, E.J. and Duraisamy, K., "Dynamic Sub-Grid Scale Models for Large Eddy Simulations Based on the Mori-Zwanzig Formalism," SIAM Computational Science and Engineering, Atlanta, GA, 2017.

- **Presentations**:

1. Parish, E.J., and Duraisamy, K., "Multiscale Modeling Using the Mori-Zwanzig Formalism and Variational Multiscale Method," 13th World Congress of Computational Mechanics, New York City, NY, 2018.
2. Parish, E.J. and Duraisamy, K., "Sub-grid scale models for discontinuous Galerkin methods based on the Mori-Zwanzig formalism," APS Division of Fluid Dynamics, Denver, Colorado, Nov. 2017.
3. Parish, E.J. and Duraisamy, K., "On the Mori-Zwanzig Formalism as a closure mechanism for the Variational Multiscale Method," VMS-2017, Seville, Spain, 2017.
4. Parish, E.J. and Duraisamy, K., "Statistical Mechanics-based Closures for Large Eddy Simulation," MICDE Symposium, Ann Arbor, MI, 2017. (Poster)
5. Parish, E.J., Gouasmi A., and Duraisamy, K., "Statistical Mechanics-based Closures for Large Eddy Simulations," APS Division of Fluid Dynamics, Portland, OR, 2016.
6. Parish, E.J., and Duraisamy, K., "Reduced Order Modeling of Turbulent Flows using Statistical Coarse-Graining" AIAA Aviation, Washington, DC, 2016.
7. Parish, and Duraisamy, K., "Quantification of Turbulence Modeling Uncertainties Using Full Field Inversion" AIAA Aviation, Dallax, TX, 2015.
8. Spurlock, W. and Parish, E.J., "Integral Methods and Eigenspace Decomposition for RANS Turbulent Mixing Flows " APS Division of Fluid Dynamics, San Francisco, CA, 2014.

Additional Experience

- **University of Wyoming** — Laramie, WY
  Division I Mens Golf — *Sept 2009 - May 2014*
  - **Notable Achievements**: GCAA All-American Scholar, Gilroy Memorial Award Recipient, Eph U. Johnson Memorial Scholar-Athlete Scholarship, Mountain West Scholar-Athlete (4x), Academic All Mountain West (4x)
- **University of Wyoming** — Laramie, WY
  Teaching Assistant — *Aug. 2012 - Dec. 2012*
- **University of Wyoming** — Laramie, WY
  First Tee Instructor — *June 2012 - July 2014*

Academic Awards

- **Academic Awards**:
  John von Neumann Postdoctoral Fellowship (2018-2020), Michigan Institute of Computational Discovery and Engineering Fellow (2016), National Science Foundation Graduate Fellowship Honorable Mention (2014,2015), Trustees Pride Full Academic Scholarship, University of Wyoming (2009-2013), Hathaway Honors Scholarship, University of Wyoming (2009-2013)

Projects

- **PyDG**: Python-based discontinuous Galerkin solver for the compressible Navier-Stokes equations. Capabilities include matrix free space-time, reacting flows, h-parallel, hierarchical numerics, and arbitrary order of accuracy. The solver is single block and intended for the development of fundamental numerics on canonical turbulence problems.
- **PySpectral**: Python-based Galerkin spectral method solver for the incompressible Navier-Stokes equations. Solver parallelized though mpi4py and has been run for up to 1024^3 DOF simulations.