(Daniel) Zhengyu Huang

516 S Catalina Ave, Pasadena, CA 91106, USA
dzhuang@caltech.edu • +1 (650) 285-7075 • http://www.its.caltech.edu/~dzhuang/

RESEARCH INTERESTS

- Numerical methods: embedded/immersed boundary method, adaptive method, high-order method.
- Data-driven approaches: physics-based neural network, Bayesian calibration/inference, model reduction, uncertainty quantification.
- Applications: fluid-structure interaction, aeroelasticity, Earth system model, material design.

ACADEMIC POSITIONS

CALTECH, California, USA

- Postdoctoral Scholar, Department of Computing+Mathematical Sciences, Department of Environmental Science and Engineering Jun 2020 –
  - Mentors: Tapio Schneider and Andrew Stuart
  - Focus: exascale Earth system model that automatically learns from diverse data sources; data-driven modeling; inverse problem; uncertainty quantification.

EDUCATION

STANFORD UNIVERSITY, California, USA

- Ph.D., Institute of Computational and Mathematical Engineering Sep 2014 – Apr 2020
- Ph.D. Minor, Department of Aeronautics and Astronautics
  - Adviser: Charbel Farhat
  - Committee members: Charbel Farhat, Eric Darve, Sanjiva Lele, Gianluca Iaccarino, Michael Saunders
  - Focus: robust embedded boundary methods for highly nonlinear fluid-structure interaction problems; supersonic parachute inflation dynamics; machine learning.
  - Cumulative GPA: 4.03 / 4.0

PEKING UNIVERSITY, Beijing, China

- B.S., Mathematics Sep 2010 – Jul 2014
  - Adviser: Tiejun Li and Jinchao Xu

PUBLICATIONS

REFEREED JOURNAL PUBLICATIONS*

[9] P. Avery, **D.Z. Huang**, W. He, J. Ehlers, A.Derkevorkian, and C. Farhat, "A Computationally Tractable Framework for Nonlinear Dynamic Multiscale Modeling of Membrane Fabric," *International Journal for Numerical Methods in Engineering*, 2021.

[8] K. Xu†, **D.Z. Huang**†, and E. Darve, "Learning Constitutive Relations Using Symmetric Positive Definite Neural Networks," *Journal of Computational Physics*, 2021.

[7] **D.Z. Huang**, M. Wong, S.K. Lele, C. Farhat, "A Homogenized Flux-Body Force Approach for Modeling Porous Wall Boundary Conditions in Compressible Viscous Flows," *AIAA Journal*, 2021.

[6] **D.Z. Huang**, W. Pazner, P.O. Persson, and M.J. Zahr, "High-Order Partitioned Spectral Deferred Correction Solvers for Multiphysics Problems," *Journal of Computational Physics*, 2020.

[5] **D.Z. Huang**†, K. Xu†, C. Farhat, E. Darve, "Learning Constitutive Relations From Indirect Observations Using Deep Neural Networks," *Journal of Computational Physics*, 2020.

[4] **D.Z. Huang**, P. Avery, and C. Farhat, "An Embedded Boundary Approach for Resolving the Contribution of Cable Subsystems to Fully Coupled Fluid-Structure Interaction," *International Journal for Numerical Methods in Fluids*, 2020.

[3] R. Borker, **D.Z. Huang**, S. Grimberg, C. Farhat, P. Avery, and J. Rabinovitch, "Mesh Adaptation Framework for Embedded Boundary Methods for CFD and Fluid-Structure Interaction," *International Journal for Numerical Methods in Fluids*, 2019.

[2] **D.Z. Huang**, P.O. Persson, and M.J. Zahr, "High-Order, Linearly Stable, Partitioned Solvers for General Multiphysics Problems Based on Implicit-Explicit Runge-Kutta Schemes," *Computer Methods in Applied Mechanics and Engineering*, 2018.

*† indicates alphabetical ordering or equal contribution

[1] **D.Z. Huang**, D. Santis, and C. Farhat, ”A Family of Position- and Orientation-Independent Embedded Boundary Methods for Viscous Flow and Fluid-Structure Interaction Problems,” *Journal of Computational Physics*, 2018.

PRE-PRINTS AND ONGOINGWORK

[6] **D.Z. Huang**, T. Schneider, and A. Stuart, ”Unscented Kalman Inversion,” *arXiv preprint arXiv:2102.01580*.

[5] S. Cao **D.Z. Huang**, ”Bayesian Calibration for Large-Scale Fluid Structure Interaction Problems Under Embedded/Immersed Boundary Framework,” *arXiv preprint arXiv:2105.09497*.

[4] J. Huang, **D.Z. Huang**, Q.Yang, G. Cheng, ”Power Iteration for Tensor PCA,” *arXiv preprint arXiv:2012.13669*.

[3] **D.Z. Huang**, J. Huang, and A. Stuart, ”Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems,” *ongoing work*.

[2] **D.Z. Huang**†, E. Qian†, and A. Stuart†, ”Operator Learning With Neural Networks,” *ongoing work.*

[1] M. De Hoop†, **D.Z. Huang**†, E. Qian†, and A. Stuart†, ”Learning the Solution Operator for Dissipative Quadratic PDEs” *ongoing work*.

REFEREED CONFERENCE PUBLICATIONS

[6] **D.Z. Huang**, P. Avery, C. Farhat, J. Rabinovitch, A. Derkevorkian and L. Peterson, “Modeling, Simulation and Validation of Supersonic Parachute Inflation Dynamics During Mars Landing,” *AIAA Science and Technology Forum and Exposition (SciTech2020)*, 2020.

[5] J. Rabinovitch, **D.Z. Huang**, R. Borker, P. Avery, C. Farhat, A. Derkevorkian, and L. Peterson, ”Towards a Validated FSI Computational Framework for Supersonic Parachute Deployments,” *AIAA Aviation 2019 Forum*, 2019.

[4] A. Derkevorkian, L. Peterson, J. Rabinovitch, **D.Z. Huang**, P. Avery, and C. Farhat, ”Effects of Structural Parameters on the FSI Simulation of Supersonic Parachute Deployments,” AIAA 2019-3276, *AIAA Aviation 2019 Forum*, 2019.

[3] **D.Z. Huang**, P.O. Persson, and M.J. Zahr, “A high-Order Partitioned Solver for General Multiphysics Problems and its Applications in Optimization,” *AIAA Science and Technology Forum and Exposition (SciTech2019)*, 2019.

[2] J. Rabinovitch, **D.Z. Huang**, P. Avery, C. Farhat, A. Derkevorkian, and L. Peterson, “Preliminary Verification and Validation Test Suite for the CFD Component of Supersonic Parachute Deployment FSI Simulations,” *AIAA Science and Technology Forum and Exposition (SciTech2018)*, 2018.

[1] **D.Z. Huang**, C. Farhat P. Avery, J. Rabinovitch, A. Derkevorkian, and L. Peterson, “Simulation of Parachute Inflation Dynamics Using an Eulerian Computational Framework for Evolving Fluid-Structure Interfaces in High Speed Turbulent Flows,” *AIAA Science and Technology Forum and Exposition (SciTech2018)*, 2018.

TALKS **CONFERENCE PRESENTATIONS**

[12] **D.Z. Huang**, J. Huang, and A. Stuart, ”Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems,” *SIAM Conference on Uncertainty Quantification*, Atlanta, Georgia, Apr 2022.

[11] **D.Z. Huang**, S. Cao, and A. Stuart, ”Bayesian Calibration for Large-Scale Fluid Structure Interaction Problems Under Embedded/Immersed Boundary Framework,” *74th Annual Meeting of the Division of Fluid Dynamics*, Phoenix, Arizona, Nov 2021.

[10] **D.Z. Huang**, W. Pazner, P. Persson, M. Zahr, ”High-Order Partitioned Spectral Deferred Correction Solvers for Multiphysics Problems,” *SIAM Conference on Computational Science and Engineering*, Fort Worth, Texas, Mar 2021.

[9] **D.Z. Huang**, P. Avery, C. Farhat, J. Rabinovitch, A. Derkevorkian and L. Peterson, “Modeling, Simulation and Validation of Supersonic Parachute Inflation Dynamics During Mars Landing,” *AIAA Science and Technology Forum and Exposition (SciTech2020)*, Orlando, Florida, Jan 2020.

[8] **D.Z. Huang**, R. Borker, P. Avery, C. Farhat, E. Hachem and A. Larcher ”Solution Adaptation in Embedded Boundary Methods: Adaptive Mesh Refinement vs. Adaptive Remeshing,” *15th U.S. National Congress on Computational Mechanics*, Austin, Texas, Jul 2019.

[7] **D.Z. Huang**, P. Avery, and C. Farhat, ”An Embedded Boundary Approach for Resolving the Contribution of Cable Subsystems to Fully Coupled Fluid-Structure Interaction,” *15th U.S. National Congress on Computational Mechanics*, Austin, Texas, Jul 2019.

[6] **D.Z. Huang**, P.O. Persson, and M.J. Zahr, “A high-Order Partitioned Solver for General Multiphysics Problems and its Applications in Optimization,” *AIAA Science and Technology Forum and Exposition (SciTech2019)*, San Diego, California, Jan 2019.

[5] **D.Z. Huang**, P. Avery, and C. Farhat, ”An Innovative Fluid-Structure Computational Framework for Supersonic Parachute Inflation Dynamics,” *13th World Congress on Computational Mechanics jointly organized with the 2nd Pan American Congress on Applied Mechanics*, New York, Jul 2018.

[4] **D.Z. Huang**, C. Farhat P. Avery, J. Rabinovitch, A. Derkevorkian, and L. Peterson, “Simulation of Parachute Inflation Dynamics Using an Eulerian Computational Framework for Evolving Fluid-Structure Interfaces in High Speed Turbulent Flows,” *AIAA Science and Technology Forum and Exposition (SciTech2018)*, Orlando, Florida, Jan 2018.

[3] **D.Z. Huang** and C. Farhat, “Conservation Error Analysis of a Family of Embedded Boundary Methods for Multi-Material Problems with Evolving Domains and Discontinuities,” *14th US National Congress on Computational Mechanics*, Montreal, Canada, Jul 2017.

[2] **D.Z. Huang**, C. Farhat and P. Avery, “Simulation of Parachute Inflation Dynamics using an Eulerian Computational Framework for Evolving Fluid-Structure Interfaces in High-Speed Turbulent Flows,” *7th International Conference on Computational Methods for Coupled Problems in Science and Engineering*, Rhodes Island, Greece, Jun 2017.

[1] **D.Z. Huang** and C. Farhat, “Energy Conservation Analysis of a Family of Embedded Boundary Methods for Multi-Material Flow and Fluid-Structure Interaction Problems,” *7th European Congress on Computational Methods in Applied Sciences and Engineering*, Crete, Greece, Jun 2016.

SEMINAR AND WORKSHOP PRESENTATIONS

[5] **D.Z. Huang**, T. Schneider, and A. Stuart, ”Unscented Kalman Inversion,” *EnKF workshop 2021*, online, Jun 2021.

[4] **D.Z. Huang**, P. Avery, C. Farhat, J. Rabinovitch, A. Derkevorkian and L. Peterson, ”Modeling Simulation and Validation of Supersonic Parachute Inflation Dynamics During Mars Landing,” *SoCal Fluids XIV*, online, Apr 2021.

[3] **D.Z. Huang**, “A Computational Framework for Parachute Inflation Dynamics in the Supersonic Regime,” in *2018 Berkeley/Stanford CompFest*, Berkeley, California, Nov 2018.

[2] **D.Z. Huang**, P. Persson, and M. Zahr, ”High-order, linearly stable, partitioned solvers for general multiphysics problems based on implicit-explicit Runge-Kutta schemes,” *Applied Mathematics Seminar at UC Berkeley*, Berkeley, California, Apr 2018.

[1] **D.Z. Huang**, “Simulation of hypersonic parachute inflation dynamics using an Eulerian computational framework,” A Computational Framework for Parachute Inflation Dynamics in the Supersonic Regime,” *2017 Berkeley/Stanford CompFest*, Berkeley, California, Apr 2017.

CONTRIBUTED TALKS

[6] E. Darve, K. Xu, **D.Z. Huang**, D. Li, J. Harris and C. Farhat, ”Physics Informed Machine Learning,” *15th U.S. National Congress on Computational Mechanics*, Austin, Texas, Jul 2019.

[5] P.O. Persson, **D.Z. Huang**, M.J. Zahr ”High-Order Partitioned Solvers and Fully Discrete Adjoints for Multiphysics Problems,” *15th U.S. National Congress on Computational Mechanics*, Austin, Texas, Jul 2019.

[4] J. Rabinovitch, **D.Z. Huang**, R. Borker, P. Avery, C. Farhat, A. Derkevorkian, and L. Peterson, ”Towards a Validated FSI Computational Framework for Supersonic Parachute Deployments,” *AIAA Aviation 2019 Forum*, San Diego, California, Jan 2019.

[3] A. Derkevorkian, L. Peterson, J. Rabinovitch, **D.Z. Huang**, P. Avery, and C. Farhat, ”Effects of Structural Parameters on the FSI Simulation of Supersonic Parachute Deployments,” AIAA 2019-3276, *AIAA Aviation 2019 Forum*, San Diego, California, Jan 2019.

[2] J. Rabinovitch, **D.Z. Huang**, P. Avery, C. Farhat, A. Derkevorkian, and L. Peterson, "Preliminary Verification and Validation Test Suite for the CFD Component of Supersonic Parachute Deployment FSI Simulations," *AIAA Science and Technology Forum and Exposition (SciTech2018)*, Orlando, Florida, Jan 2018.

[1] A. Morlot, **D.Z. Huang** and C. Farhat, "A Numerical Framework for Enforcing a Class of Internal or Boundary Conditions in CFD and FSI Computations," *7th International Conference on Computational Methods for Coupled Problems in Science and Engineering*, Rhodes Island, Greece, Jun 2017.

AWARDS & SCHOLARSHIPS

- Gene Golub Dissertation Award, Stanford University
  Recognition for best ICME thesis in 2019-2020 academic year — Jun 2020
- Gene Golub Graduate Fellowship, Stanford University — 2014 – 2016
- Gold Medalist in Team Contest, and Silver Medalist in Individual Contest of Applied and Computational Mathematics, S.-T. Yau College Student Mathematics Contests — Aug 2013
- Gold Medalist in the Chinese Mathematical Olympiad — Jan 2010

TEACHING & MENTORING EXPERIENCE

TEACHING

- AA214B: Numerical Methods for Compressible Flows, Stanford — Winter 2018
- AA214B: Numerical Methods for Compressible Flows, Stanford — Winter 2019
- AA109Q: Aerodynamics of Race Cars, Stanford — Spring 2020

MENTORING

- AHPCRC Summer Institute for Undergraduates in Computational Science and Engineering
  - Adam Stempeck, New Mexico State University
    Project: Package parachutes (Best Project Award) — Summer 2016
  - Erick John Blankenberg, Stanford University
    Project: Adaptive mesh refinement — Summer 2017
  - Jaime E. Regis, New Mexico State University
    Project: Adaptive mesh refinement — Summer 2017
  - Luis F. Aranda, New Mexico State University
    Project: Adaptive mesh refinement — Summer 2017

REVIEWER FOR INTERNATIONAL JOURNALS AND CONFERENCES

- International Journal for Numerical Methods in Engineering
- International Journal for Numerical Methods in Fluid
- Journal of Computational Physics
- Computer Methods in Applied Mechanics and Engineering
- SIAM Journal on Uncertainty Quantification

OTHERS

- Languages: Chinese, English
- Skills: Python, Julia, C, C++, CUDA, MPI, OpenMP parallelism