黄政宇 (Daniel Zhengyu Huang)

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ACADEMIC POSITIONS

PEKING UNIVERSITY, Beijing, China

- Tenure-track Assistant Professor, Beijing International Center for Mathematical Research Aug 2023 –

CALTECH, California, USA

- Postdoctoral Scholar, Department of Computing+Mathematical Sciences, Department of Environmental Science and Engineering Jun 2020 – Aug 2023
  - Mentors: Andrew M. Stuart and Tapio Schneider
  - Focuses: exascale Earth system model that automatically learns from diverse data sources, Bayesian inference, inverse problem, neural operator.

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
  - Advisor: Charbel Farhat
  - Committee members: Charbel Farhat, Eric Darve, Sanjiva Lele, Gianluca Iaccarino, Michael Saunders
  - Focuses: 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
  - Advisors: Tiejun Li and Jinchao Xu

GRANTS

- National Science Foundation of China (Major Program): Differentiable Physical Computing Paradigm for Spatial Intelligence (Co-Principal Investigator, CNY 13,734,300). 2026– 2030
- National Key R&D Program of China : Neural Operator Learning: Theory, Methods, and Applications (Principal Investigator, CNY 3,000,000). 2026– 2030
- National Science Foundation of China (General Program): Calibration and Computational Models Uncertainty Quantification for Large-Scale (Principal Investigator, CNY 430,000). 2025– 2028
- Excellent Young Scientists Fund (Overseas): Intelligent Computational Model and Its Engineering Application (Principal Investigator, CNY 1,000,000). 2024– 2026
- Industrial Project: AI for Mathematics (Co-Principal Investigator, CNY 390,000). 2024– 2025
- Start-up Grant of Peking University (Principal Investigator, CNY 400,000). 2023– 2026
- National Science Foundation: Data-Driven Earth System Modeling (Participant, USD 2,499,842) 2018– 2023
- NASA Early Stage Innovations: An Innovative High Fidelity Multidisciplinary Computational Framework for Parachute Inflation Dynamics (Participant, USD 628,712) 2017– 2020
- Jet Propulsion Laboratory: A Numerical Simulator for Supersonic Inflatable Aerodynamic Decelerators (Participant, USD 1,170,000) 2016– 2019

PUBLICATIONS

REFEREED JOURNAL PUBLICATIONS*

[26] Y. Chen†, **D.Z. Huang**†, J. Huang†, S. Reich†, and A.M. Stuart†, "Sampling via Gradient Flows in the Space of Probability Measures," *Mathematics of Computation*, 2026

[25] B. Che†, Y. Chen†, Z. Huan†, **D.Z. Huang**†, W. Wang†, "Stable Derivative Free Gaussian Mixture Variational Inference for Bayesian Inverse Problems," *SIAM Journal on Scientific Computing*, 2025.

[24] C. Zeng†,Y. Zhang†, J. Zhou†, Y. Wang, Z. Wang, Y. Liu, L. Wu, **D.Z. Huang**, "Point Cloud Neural Operator for Parametric PDEs on Complex and Variable Geometries," *Computer Methods in Applied Mechanics and Engineering*, 2025.

*† indicates alphabetical ordering or equal contribution

[23] **D.Z. Huang**†, J. Huang†, and Z. Lin†, "Convergence Analysis of Probability Flow ODE for Score-based Generative Models," *IEEE Transactions on Information Theory*, 2025.

[22] H. Jiang, J.L. Pfister, **D.Z. Huang**, S. Cao, "Koopman Reduced-Order Modeling and Analysis of Flag Flapping in the Wake of a Cylinder," *Physical Review E*, 2025.

[21] Y. Chen†, **D.Z. Huang**†, J. Huang†, S. Reich†, A. M. Stuart†, "Efficient, Multimodal, and Derivative-Free Bayesian Inference With Fisher-Rao Gradient Flows," *Inverse Problems*, 2024.

[20] L. Wang, **D.Z. Huang**, Y. Chen, Y. Liu, N. Du, W. Li, "Joint Inversion of Receiver Function and Surface Wave Dispersion Based on the Unscented Kalman Inversion," *Geophysical Journal International*, 2024.

[19] **D.Z. Huang**, N.H. Nelsen, M. Trautner, "An Operator Learning Perspective on Parameter-To-Observable Maps," *Foundations of Data Science*, 2024.

[18] T. Zhou†, X. Wan†, **D.Z. Huang**, Z. Li, Z. Peng, A. Anandkumar, J. Brady, P. Sternberg, and C. Daraio, "AI-aided Geometric Design of Anti-infection Catheters," *Science Advances*, 2024

[17] Z. Li, **D.Z. Huang**, B. Liu, and A. Anandkumar, "Fourier Neural Operator with Learned Deformations for PDEs on General Geometries," *Journal of Machine Learning Research*, 2023

[16] G.B. Arouse†, **D.Z. Huang**†, and J. Huang†, "Long Random Matrices and Tensor Unfolding," *The Annals of Applied Probability*, 2023

[15] R. Oliver, I. Lopez-Gomez, A. Garbuno-Iñigo, **D.Z. Huang**, E. Bach, and J. Wu, "EnsembleKalmanProcesses. jl: Derivative-free ensemble-based model calibration," *Journal of Open Source Software*, 2022

[14] **D.Z. Huang**, J. Huang, S. Reich, and A.M. Stuart, "Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems," *Inverse Problem*, 2022

[13] M. De Hoop†, **D.Z. Huang**†, E. Qian†, and A.M. Stuart†, "The Cost-Accuracy Trade-Off In Operator Learning With Neural Networks," *Journal of Machine Learning*, 2022

[12] **D.Z. Huang**, T. Schneider, and A.M. Stuart, "Iterated Kalman Methodology for Inverse Problems," *Journal of Computational Physics*, 2022

[11] S. Cao and **D.Z. Huang**, "Bayesian Calibration for Large-Scale Fluid Structure Interaction Problems Under Embedded/Immersed Boundary Framework," *International Journal for Numerical Methods in Engineering*, 2022.

[10] J. Huang, **D.Z. Huang**, Q.Yang, and G. Cheng, "Power Iteration for Tensor PCA," *Journal of Machine Learning Research*, 2022.

[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, and 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, and 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.

[1] **D.Z. Huang**, D. De 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 ONGOING WORK

[7] M.Han†, **D.Z. Huang**†, Y. Wang†, Y. Zhang†, J. Zhou†, "Geometric Generalization of Neural Operators from Kernel Integral Perspective," *https://arxiv.org/abs/2602.01498*.

[6] B. Che†, Y. Chen†, **D.Z. Huang**†, X. Mao†, W. Wang†, "Adaptive Exponential Integration for Stable Gaussian Mixture Black-Box Variational Inference," *https://arxiv.org/abs/2601.14855*.

[5] **D.Z. Huang**†, J. Huang†, and Z. Lin†, "Fast Convergence for High-Order ODE Solvers in Diffusion Probabilistic Models," *https://arxiv.org/pdf/2506.13061*.

[4] Y. Guan, P. Hassanzadeh,T. Schneider, O. Dunbar, **D.Z. Huang**, J. Wu, I. Lopez-Gomez,"Online Learning of Eddy-Viscosity and Backscattering Closures for Geophysical Turbulence Using Ensemble Kalman Inversion," *arXiv preprint arXiv:2302.11024*.

[3] J.A. Carrillo†, Y. Chen†, **D.Z. Huang**†, J. Huang†, D. Wei†, "Fisher-Rao Gradient Flow: Geodesic Convexity and Functional Inequalities," *arXiv preprint arXiv:2312.06980*.

[2] D. Yatunin, et al.,"The Climate Modeling Alliance Atmosphere Dynamical Core: Concepts, Numerics, and Scaling," *preprint*.

[1] Z. Liu, Y. Wu, **D.Z. Huang**, H. Zhang, X. Qian, S. Song, "SPFNO: Spectral Operator Learning for PDEs With Dirichlet and Neumann Boundary Conditions," *arXiv preprint arXiv:2312.06980*.

REFEREED CONFERENCE PUBLICATIONS

[8] Z. Huang, **D.Z. Huang**, T. Xiao, D. Ma, Z. Ming, H. Shi, and Y. Wen, " Improving Monte Carlo Tree Search for Symbolic Regression," *Conference on Neural Information Processing Systems (NeurIPS2025)*, 2025.

[7] L. Sun†, **D.Z. Huang**†, H. Sun, and J. Wang, " Bayesian Spline Learning for Equation Discovery of Nonlinear Dynamics with Quantified Uncertainty," *Conference on Neural Information Processing Systems (NeurIPS2022)*, 2022.

[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

[16] **D.Z. Huang**, "The Cost-Accuracy Trade-Off In Operator Learning With Neural Networks," *The International Council for Industrial and Applied Mathematics*, Tokyo, Japan, Aug 2023.

[15] **D.Z. Huang**, J. Huang, S. Reich, and A.M. Stuart, "Neural Operator for Multidisciplinary Engineering Design," *17th U.S. National Congress on Computational Mechanics*, Albuquerque, New Mexico, Jun 2023.

[14] **D.Z. Huang**, C. Yifan, J. Huang, S. Reich, and A.M. Stuart, "Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems," *SIAM Conference on Optimization*, Seattle, Washington, May 2023.

[13] **D.Z. Huang**, J. Huang, S. Reich, and A.M. Stuart, "Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems," *SIAM Conference on Mathematics of Data Science*, San Diego, California, Sep 2022.

[12] **D.Z. Huang**, J. Huang, S. Reich, and A.M. 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.M. 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, and 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

[18] **D.Z. Huang**, J. Huang, S. Reich, and A.M. Stuart, "Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems," *Statistics and applied probability seminar*, UCSB, Santa Barbara, Jun 2023.

[17] **D.Z. Huang**, "Data-Aware Computational Models for Science and Engineering," *Mechanical engineering and materials science seminar*, Duke, Durham, Mar 2023.

[16] **D.Z. Huang**, "Data-Aware Computational Models for Science and Engineering," *Aerospace engineering and engineering mechanics seminar*, UT Austin, Austin, Feb 2023.

[15] **D.Z. Huang**, "Data-Aware Computational Models for Science and Engineering," *Mechanical engineering and applied mechanics seminar*, Upenn, Philadelphia, Feb 2023.

[14] **D.Z. Huang**, "Data-Aware Computational Models for Science and Engineering," *Applied math colloquium*, UMN, Twin Cities, Feb 2023.

[13] **D.Z. Huang**, "Next-Generation Mathematical Methods for Science and Engineering," *Applied math colloquium*, PKU, Beijing, Nov 2022.

[12] **D.Z. Huang**, J. Huang, S. Reich, and A.M. Stuart, "Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems," *Applied math colloquium*, UCLA, Los Angeles, Oct 2022.

[11] **D.Z. Huang**, "Neural Operator for Multidisciplinary Engineering Design," *AI + Math Colloquium*, Shanghai Jiao Tong University, China, Oct 2022.

[10] **D.Z. Huang**, J. Huang, S. Reich, and A.M. Stuart, "Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems," *Numerical Analysis and Scientific Computing Seminar at Courant*, New York University, New York, Oct 2022.

[9] **D.Z. Huang**, Z. Li, B. Liu, and A. Anandkumar, "Fourier Neural Operator with Learned Deformations for PDEs on General Geometries," *Workshop on inverse problems, deep learning and geophysics*, Rice University, Texas, Jun 2021.

[8] **D.Z. Huang**, J. Huang, S. Reich, and A.M. Stuart, "Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems," *Workshop on PDE-constrained Bayesian inverse problems: Interplay of spatial statistical models with Machine Learning in PDE discretizations*, University of Vienna, Austria Jun 2021.

[7] **D.Z. Huang**, J. Huang, S. Reich, and A.M. Stuart, "Efficient Derivative-Free Bayesian Inference for Large-Scale Inverse Problems," *SOCAMS 2022*, Harvey mudd college, California, May 2022.

[6] **D.Z. Huang**, S. Cao, and A.M. Stuart, "Bayesian Calibration for Large-Scale Fluid Structure Interaction Problems Under Embedded/Immersed Boundary Framework," *SoCal Fluids XV*, UCLA, California, May 2022.

[5] **D.Z. Huang**, T. Schneider, and A.M. 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," *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," *2017 Berkeley/Stanford CompFest*, Berkeley, California, Apr 2017.

TEACHING

TEACHING

- Scientific Machine Learning, PKU — Autumn 2025
- Inverse Problems and Data Assimilation, PKU — Spring 2025
- Scientific Machine Learning, PKU — Autumn 2024
- Inverse Problems and Data Assimilation, PKU — Spring 2024
- 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
- ACM 11: Introduction to Computational Science and Engineering, Caltech (Guest lecturer) — Spring 2022

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

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
- Journal of Scientific Computing

OTHERS

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