

Qi Wang

435 PSFA Building, San Diego State University – San Diego, CA, 92182

☎ +1(305)394-1722 • ✉ qwang4@sdsu.edu

Summary

My research exploits state-of-the-art mathematical and computational methods to address important challenges in inverse problems for fluid dynamics. High-performance simulation techniques are developed and adopted to predict and optimize complex turbulent flows and to optimally place sensors and optimize the interpretation of their measurements. My past and ongoing research answer this question by exploiting the discrete adjoint operator and generative machine learning methods in different scenarios: extreme events detection and localization from noisy sensor measurement, multi-scale turbulent flow state estimation from sparse measurements, sensitivity analysis using the domain of dependence, forcing reconstruction in particle-laden flows, and stable diffusion models in inverse advection-diffusion process.

Work Experience

San Diego State University

Assistant Professor in Aerospace Engineering

San Diego, CA, United States

2021 – Present

Johns Hopkins University

Postdoc in Mechanical Engineering

Baltimore, MD, United States

2020 – 2021

Education

Johns Hopkins University

Ph.D. in Mechanical Engineering

Baltimore, MD, United States

2016–2020

Johns Hopkins University

MSE in Mechanical Engineering

Baltimore, MD, United States

2014–2016

Beijing University

Bachelor of Science in Theoretical & Applied Mechanics

Beijing, China

2010– 2014

Minor degree in Mathematics

Active Grants

- NSF-2431610: (Principle Investigator, \$300k) Physics-Guided Generative Artificial Intelligence for Inverting Chaotic Advection-Diffusion Dynamics, 08/01/2024 - 07/31/2027.
- NSF-2332057: (Principle Investigator, \$260k) Towards efficient state estimation in wall-bounded flows: Hierarchical adjoint data assimilation, 08/15/2023 - 07/31/2026.
- NSF-2341393: (Principle Investigator, \$200k) Efficient identification of passive scalar source in turbulence using the Probabilistic Domain of Dependence (P-DoD), 04/01/2024 - 03/31/2026.
- AFOSR-23RT0619: (Co-Principle Investigator, \$300k) Inference of Forcing Kernels in Generalized, Multi-Physics, Dynamic Systems, 08/01/2023 - 07/31/2027.
- California Education Learning Lab (Principle Investigator, \$75k): Animate Math Concepts in Engineering Education using Large Language Models, 01/01/2024 - 06/01/2026.

Publications

- Daniel Domínguez-Vázquez, Nicolas Escobar-Castaneda, **Qi Wang**, & Gustaaf B. Jacobs. Inference of inertial particle dynamics from limited measurements. *Physics of Fluids*, 37(4) (2025).
- Abassi, Mohamed Amine, **Qi Wang**, and Xiaofeng Liu. "Adjoint-based data assimilation in a subdomain using omnidirectional-integration-enabled pressure Dirichlet boundary conditions." *Physics of Fluids* 37.1 (2025).
- **Qi Wang**, and Tamer A. Zaki. "Domain of dependence for wall-pressure measurements in high-speed boundary layers." *Journal of Fluid Mechanics* 1009 (2025): A67.
- **Qi Wang**, and Xiaofeng Liu. "Green's function integral for pressure reconstruction and its equivalence with Omnidirectional integration", *Physics of Fluids*, 35(7):077113 (2023).
- **Qi Wang**, Mengze Wang, and Tamer A. Zaki. "What is observable from wall data in turbulent channel flow?." *Journal of Fluid Mechanics* 941 (2022): A48.
- **Qi Wang**, Yosuke Hasegawa, and Tamer A. Zaki. "Spatial reconstruction of steady scalar sources from remote measurements in turbulent flow." *Journal of Fluid Mechanics* 870 (2019): 316-352.
- Mengze Wang, **Qi Wang**, and Tamer A. Zaki. "Discrete adjoint of fractional-step incompressible Navier-Stokes solver in curvilinear coordinates and application to data assimilation." *Journal of Computational Physics* 396 (2019): 427-450.
- Vincent Mons, **Qi Wang**, and Tamer A. Zaki. "Kriging-enhanced ensemble variational data assimilation for scalar-source identification in turbulent environments." *Journal of Computational Physics* 398 (2019): 108856.

Publications in progress

- **Qi Wang** and Zejian You. Localization of sources in weakly nonlinear fluid systems using linear and quadratic sensitivity analysis. Submitted to *Physics Review Fluids*, 2025. *Currently under review*.
- Cleary, Andrew, **Qi Wang**, and Tamer A. Zaki. "Latent-space variational data assimilation in two-dimensional turbulence." arXiv preprint arXiv:2512.15470 (2025).
- **Qi Wang** and Tamer Zaki. Mitigating adjoint chaos in wall turbulence. Submitted to *JFM Rapid*, 2025, *Currently under review*.
- Anqiao Ouyang, Hongyi Ke and **Qi Wang**. Fourier-Invertible Neural Encoder (FINE) for Homogeneous Flows. Released on arxiv, current preparation for IEEE.
- Hongyi Ke, Zejian You and **Qi Wang** Preconditioned Adjoint Data Assimilation for Two Dimensional Decaying Turbulence. Under preparation for *Physics Review Fluids*.
- Xiaomeng Hu, **Qi Wang** and Gustaaf Jacobs, Forcing Inference via the Liouville Adjoint: Connecting Particle Dynamics and Phase Space Descriptions. Under preparation for *Journal of Computational Physics*.
- Zejian You, Tobias K. S. Ritschel, **Qi Wang** and Gustaaf Jacobs, Adjoint-enabled inference of particle history forces using a recursive-memory formulation. Under preparation for *Physics Review Fluids*.
- Yexiao He, Ang Li, **Qi Wang**. Turning back the clock on turbulence with diffusion models. Under preparation for *Nature Communications*.
- Junhao Zhao, Yexiao He, Ang Li, **Qi Wang**. Diffusion Model for Inverse Physics Problem of Passive Scalar Transport in Chaotic Flow Fields. Under preparation for *Nature Communications*.

- Zejian You, Mohamed Amine Abassi, **Qi Wang**, and Xiaofeng Liu. Denoising Reconstruction of Pressure Fields using Gaussian Process Regression with Measured Pressure Gradient. Under preparation for the Journal of Computational Physics.
- Mohamed Amine Abassi, **Qi Wang**, and Xiaofeng Liu. Scalar Field Reconstruction on an Arbitrary Closed Surface from Measured Scalar Gradient Distributions and the Unfolded Surface Integration Method. Under preparation for the Journal of Computational Physics.
- Aastha Joshi, Hongyi Ke, Meet Gajjar, **Qi Wang**, Jun Chen. LLM-Driven Automated Animation of STEM Concepts using Manim: Design, Implementation, and Educational Impact. Under preparation for IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES.
- Leopoldo Gutierrez and Qi Wang, Mixed Lagrangian-Eulerian Data Assimilation for turbulent channel flows, under preparation for AIAA SciTech 2026.
- Yifan Du and Qi Wang, Inverse Reconstruction of Free-Stream Vortices Using Surface Pressure on a Joukowski Airfoil, under preparation for AIAA SciTech 2026.
- Leopoldo Gutierrez and Qi Wang, Reconstructing Dangerous Flow Events Using the Domain of Dependence from Surface Pressure Data, under preparation for AIAA SciTech 2026.

Conference Presentations

- Ritik Mody and **Qi Wang**. "Fast Multipole Method for Two-Dimensional Pressure Reconstruction from Noisy Gradient Information." Bulletin of the American Physical Society (2024).
- **Qi Wang** and Tamer Zaki. "Ensemble-averaged domain of dependence of wall stress in turbulent channel flow." Bulletin of the American Physical Society (2024).
- Carol Klingler and **Qi Wang**. "Preconditioned Adjoint Data-Assimilation for Two-dimensional Decaying Isotropic Turbulence." Bulletin of the American Physical Society (2024).
- Mohamed A. Abassi, **Qi Wang**, and Xiaofeng Liu. "The impact of Omnidirectional Integration on the pressure solver in subdomain data assimilation for incompressible flows." Bulletin of the American Physical Society (2024).
- Zejian You, **Qi Wang**, and Xiaowei Zhu. "Adjoint-enhanced positioning algorithm for sensor network in turbulent environments." Bulletin of the American Physical Society (2023).
- Nicolas Escobar-Castaneda, **Qi Wang**, and Gustaaf Jacobs. "Inference of forcing kernels from limited observations in particle cloud tracers." Bulletin of the American Physical Society (2024).
- **Qi Wang** and Xiaofeng Liu. "Adjoint-based Data Assimilation using synthetic PIV data in wall-bounded turbulent flows." ISPIV 2023.
- Abassi, Mohamed Amine, **Qi Wang**, and Xiaofeng Liu. "Data Assimilation for isotropic turbulent flow and Pressure Computation using Omnidirectional Integration." AIAA SCITECH 2023 Forum. 2023.
- You, Zejian, **Qi Wang**, and Xiaofeng Liu. "Pressure Reconstruction from the Measured Pressure Gradient Using Gaussian Process Regression." AIAA SCITECH 2023 Forum. 2023.
- Zejian You and **Qi Wang**. "Pressure Reconstruction from Noisy Measurements of Pressure Gradient by Gaussian Process Regression in Isotropic Turbulence." Bulletin of the American Physical Society (2022).
- Zejian You and **Qi Wang**. "Pressure Reconstruction from Noisy Measurements of Pressure Gradient by Gaussian Process Regression in Isotropic Turbulence." Bulletin of the American Physical Society (2022).
- Mohamed Amine Abassi, **Qi Wang**, and Xiaofeng Liu. "Data Assimilation for Turbulent Channel Flow and Pressure Computation using Omnidirectional Integration." Bulletin of the

American Physical Society (2022).

- Daniel Dominguez-Vazquez, **Qi Wang** and Gustaaf B Jacobs. "Adjoint-based particle forcing reconstruction from sparse measurements with uncertainty quantification." Bulletin of the American Physical Society (2022).
- **Qi Wang** and Tamer Zaki. "An eigen-ensemble algorithm for localization of scalar sources in turbulent environments." Bulletin of the American Physical Society (2022).
- Buchta, David, **Qi Wang**, and Tamer Zaki. "Domain of dependence of wall-pressure measurements in transitional high-speed boundary layers." Bulletin of the American Physical Society (2021).
- Simon Toedtli, **Qi Wang** and Tamer Zaki. "Adjoint-variational reconstruction of turbulence in isothermal and stratified channel flow ." Bulletin of the American Physical Society (2021).
- **Qi Wang**. "Adjoint-based data assimilation and Hessian analysis of turbulent flows." Computational Science Research Center, San Diego State University (2021).
- **Qi Wang** and Tamer Zaki. "An eigen-ensemble-variational algorithm for identifying scalar sources from remote measurements in turbulent environments." Bulletin of the American Physical Society (2019).
- **Qi Wang** and Tamer Zaki. "Fundamental limitations in initial-state estimation using surface measurements in wall turbulence." Bulletin of the American Physical Society (2018).
- Vincent Mons, **Qi Wang**, and Tamer Zaki. "Ensemble-based data assimilation and optimal sensor placement for scalar source reconstruction." Bulletin of the American Physical Society (2017).
- **Qi Wang**, et al. "Adjoint-optimization algorithm for spatial reconstruction of a scalar source." Bulletin of the American Physical Society (2016).
- **Qi Wang**, Mengze Wang, and Tamer A. Zaki. "Difficulty of State Estimation from Wall Measurements in Turbulent Channel Flow" November 2018, Graduate Seminar in the Department of Mechanical Engineering, Johns Hopkins University.
- **Qi Wang** and Tamer A. Zaki. "Direct Numerical Simulations of Wake-Induce Transition in Three-Dimensional Boundary Layer" December 2016, Graduate Seminar in the Department of Mechanical Engineering, Johns Hopkins University.
- **Qi Wang**, Vincent Mons, and Tamer A. Zaki. "Data-Assimilation for Scalar-Source Reconstruction" April 2017, Graduate Seminar in the Department of Mechanical Engineering, Johns Hopkins University.
- **Qi Wang**, Vincent Mons, and Tamer A. Zaki. "An Adjoint-Based Algorithm for Detection of Scalar Release" October 2015, Graduate Seminar in the Department of Mechanical Engineering, Johns Hopkins University.

Teaching Chronology

AE 341, Fluid Mechanics Laboratory

San Diego State University

AUG. 2021 – DEC. 2021

AE 340, Fluid Mechanics, Undergraduate class

San Diego State University

JAN. 2022 – MAY. 2022

AE 340, Fluid Mechanics, Undergraduate class

San Diego State University

AUG. 2022 – DEC. 2022

AE 620, Incompressible Aerodynamics, graduate class

San Diego State University

JAN. 2023 – MAY. 2023

AE 340, Fluid Mechanics, Undergraduate class <i>San Diego State University</i>	<i>AUG. 2023 – DEC. 2023</i>
AE 600, Advanced Inverse Problems, graduate class <i>San Diego State University</i>	<i>AUG. 2023 – DEC. 2023</i>
AE 620, Incompressible Aerodynamics, graduate class <i>San Diego State University</i>	<i>JAN. 2024 – MAY. 2024</i>
AE 301, Incompressible Aerodynamics, undergraduate class <i>San Diego State University</i>	<i>JAN. 2024 – MAY. 2024</i>
AE 602, Computational Fluid Dynamics, graduate class <i>San Diego State University</i>	<i>AUG. 2024 – DEC. 2024</i>
AE 301, Incompressible Aerodynamics, undergraduate class <i>San Diego State University</i>	<i>AUG. 2024 – DEC. 2024</i>
AE 302, High-speed aerodynamics, undergraduate class <i>San Diego State University</i>	<i>JAN. 2025 – MAY. 2025</i>
AE 302, High-speed aerodynamics, undergraduate class <i>San Diego State University</i>	<i>AUG. 2025 – DEC. 2025</i>
AE 666, Advanced Inverse Problems, graduate class <i>San Diego State University</i>	<i>AUG. 2025 – DEC. 2025</i>

Professional Affiliations

American Physics Society
American Institute of Aeronautics and Astronautics

Honors and Awards

PianoTexas Concerto Competition Winner	PianoTexas <i>JUNE. 2024</i>
JHU Mech Eng Graduate Research Fellowship	Johns Hopkins University <i>AUG. 2014 – AUG. 2015</i>
CUHK Research Internship Scholarship <i>Financial Stipend awarded</i>	Chinese University of Hong Kong <i>JUN. 2013 – AUG. 2013</i>
Silver Medal <i>The 25th China Mathematics Olympiad</i>	Chong Qin, China <i>APRIL. 2010</i>
Bronze Medal <i>The 24th China Mathematics Olympiad</i>	Hai Nan, China <i>APRIL. 2009</i>
Gold Medal <i>Seattle International Piano Competition</i>	Washington, Seattle, USA <i>OCT. 2019</i>