

September 27, 2025

Tan Bui-Thanh
The Oden Institute for Computational Engineering and Sciences
The Department of Aerospace Engineering & Engineering Mechanics
Phone: +1 (617) 820-2676
Email: tanbui@oden.utexas.edu

I am a Professor and Endowed William J. Murray Jr. Fellow in Engineering No. 4 of the Oden Institute and the Department of Aerospace Engineering & Engineering Mechanics at The University of Texas at Austin. My research bridges computational fluid dynamics (CFD), computational geophysics, and scientific machine learning (SciML) for real-time digital twins, grounded in high-performance computing (HPC) and uncertainty quantification (UQ). I am currently the director of the Center for Scientific Machine Learning at the Oden Institute. I was a former elected vice president of the SIAM Texas-Louisiana Section and a former elected secretary of the SIAM SIAG/CSE. I was an NSF early CAREER recipient (jointly funded by the Office of Advanced Cyberinfrastructure and Division of Mathematical Sciences), the Oden Institute distinguished research award, a two-time winner of the Moncrief Faculty Challenging award, and a Gordon Bell Prize finalist.

Large-Scale Computational Fluid Systems, Multiscale/Multiphysics, HPC. In fluid dynamics, my group has advanced high-order, scalable algorithms for incompressible and compressible Navier-Stokes equations (including high-Mach regimes), compressible Euler equations, and magnetohydrodynamics. We have pioneered model-constrained SciML approaches, called `Learn2Solve`, that integrate physical invariants and stability, rigor of numerical methods, and the speed of AI/ML approaches to deliver fast and accurate predictions suitable for physics-based applications as well as control and design optimization. Such approaches could not only solve challenging problems but also be **interpretable and reliable** for **out-of-distribution (OOD)** dynamics/information/regimes. Such generalization capability is not possible by existing methods (see, e.g., an `Learn2Solve` approach, called `DGNet`, for an OOD supersonic/hypersonic flows). Our approaches are designed, trained, tested, and operated on the NSF leadership computing systems at the Texas Advanced Computing Center.

Large-Scale Computational Wave Propagation, Machine Learning, and real-time digital twins. My team has developed end-to-end computational and SciML pipelines for **seismic imaging, inversion, and subsurface characterization**. On the forward side, we develop advanced high-order discontinuous Galerkin/DPG solvers for coupled elastic-acoustic, electromagnetic (EM) wave propagation, and shallow water equations on the sphere that run efficiently on GPUs/CPU at both NSF and DOE leadership-class systems. On the inverse side, we integrate **adjoint-based optimization** and **scalable Bayesian UQ with data-assimilative SciML** for real-time imaging and inversion workflows. For monitoring and decision support, we design *real-time, uncertainty-aware* SciML algorithms for digital twins that fuse streaming sensors with first-principles models and numerical methods, enabling real-time robust anomaly detection, optimal control, monitoring, and “what-if” scenarios.

Research plan & collaborations. I am naturally fit in a fertile interdisciplinary environment. I could lead/co-lead initiatives in (a) scalable advanced high-order discretizations and multilevel solvers for complex multiscale and multiphysics applications, (b) online data assimilation with certified UQ, (c) physics-aware SciML learning and reduced-order modeling, and (d) Accelerator implementations with

a runway toward **quantum-accelerated SciML** for selected kernels. Internationally, I will continue to build multi-PI programs that link modeling, data, and computation at scale, while actively pursuing competitive internal and external funding.

Teaching. I am deeply committed to undergraduate and graduate educations. Over the past six years, I have taught a graduate course on **Fundamental and Advanced Machine Learning & Data Science**, and I am currently teaching a graduate course on **Quantum Algorithms for Computational Science & Engineering** (replacing the **The applied mathematics** graduate class that I have taught for the past 10 years). I intend to continue both. Because my PhD is in CFD with a minor in fluids, I could teach **advanced fluid mechanics** and **geophysics** (both hydrostatics and nonhydrostatics). In addition, I can offer: (i) Scalable Parallel High-Order Discontinuous Galerkin Finite Element Methods, and (ii) Digital Twins with SciML (physics-aware, numerical methods aware, and data-assimilative modeling; real-time inference/control; operator learning; deployment on HPC/edge; safety and certification via UQ).

Mentoring, service, and community building. I have had a diverse cohort of Ph.D. students, postdocs, and research scientists, co-advise across departments, and create project-based studios aligned with government and industrial partner needs. I was one of the founding members of the new undergraduate major, called Computational Engineering, in Computational Sciences, Engineering, and Mathematics in the Department of Aerospace Engineering & Engineering Mechanics. I was the chairman of the new integrated 5-year Bachelor's/Master's degree in CSEM in the Department of Aerospace Engineering & Engineering Mechanics and the Oden Institute. Services include curriculum development, strategic hiring support in Computational Sciences & Engineering (CSE), AI/ML, and HPC, organization of workshops and summer schools on digital twins and UQ, and open-source software stewardship (documentation, continuous integration, reproducibility) to amplify the global visibility of my university.

Sincerely yours,

Tan Bui-Thanh, PhD., Professor
Endowed William J. Murray, Jr. Fellow in Engineering No. 4
Director of the Center for Scientific Machine Learning at the Oden Institute
Leader of Pho Group
Department of Aerospace Engineering and Engineering Mechanics
The Oden Institute for Computational Engineering and Sciences
The University of Texas at Austin
E-mail: tanbui@oden.utexas.edu
Office: ASE 4.220 and POB 3.118
Phone: (512) 471-8176 and (512) 232-8179

P.S.: Selected flagship projects & publications

- **Scalable high-order DG libraries for 3D elastic/acoustic, 3D Maxwell, Compressible flows on leadership HPC:** Gordon Bell Prize finalist for Bayesian global seismic inversion work (ACM/IEEE Supercomputing, SINUM, CMAME, SIAM SISC).
 - **SciML for seismic imaging/inversion with Bayesian UQ and adjoint-based optimization:** end-to-end forward/inverse workflows (SIAM SISC, JCP, CMAME, Inverse Problems, PMLR, etc).
 - **High-order CFD (DG/DPG)** for incompressible/compressible NavierStokes and compressible magnetohydrodynamics systems (SIAM SISC, JCP, CMAME).
 - **Faster-than-real-time SciML algorithms** for challenging supersonic/hypersonic regimes; deployment-ready for control (SIAM SISC, CMAME).
-

-
- **Applied Digital Twins:** current federal and industrial projects on Tokamak disruption, plasma arc for steelmaking, hybrid-engine twins, and hurricane/storm-surge decision support.
-