Spencer H. Bryngelson

1 Basic information

Title: Assistant Professor, School of Computational Science & Engineering
Assistant Professor by Courtesy (0%), Daniel Guggenheim School of Aerospace Engineering
Assistant Professor by Courtesy (0%), George W. Woodruff School of Mechanical Engineering
Institution: Georgia Institute of Technology
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2 Education

- University of Illinois at Urbana–Champaign
  - (2018) Doctor of Philosophy, Theoretical & Applied Mechanics
    - Advisor: Jonathan Freund
  - (2015) Master of Science, Theoretical & Applied Mechanics
- University of Michigan–Dearborn
  - (2013) Bachelor of Science, Mechanical Engineering
  - (2013) Bachelor of Science, Engineering Mathematics

3 Positions held

- (2021–Present) Assistant Professor, School of Computational Science & Engineering, Georgia Institute of Technology
- (2023–Present) Assistant Professor by Courtesy (0%), Daniel Guggenheim School of Aerospace Engineering, College of Engineering, Georgia Institute of Technology
- (2024–Present) Assistant Professor by Courtesy (0%), George W. Woodruff School of Mechanical Engineering, College of Engineering, Georgia Institute of Technology
- (2022) Visiting Scholar, Stanford University, Center for Turbulence Research (Summer Program)
- (2018–21) Senior Postdoctoral Scholar, California Institute of Technology, with Tim Colonius
- (2019) Visiting Researcher, Massachusetts Institute of Technology, with Themis Sapsis
- (2018) Postdoctoral Researcher, XPACC (PSAAP II center), with Carlos Pantano, Dan Bodony, Jon Freund

4 Research support

4.1 Pending grants

- (2024–29) PI: DOE Early Career Research Program "*Radial basis function numerics enable massively parallel, high-order accurate, mesh-free, and shock-stable PDE solvers*" ($875K)
- (2024–29) PI: NSF CAREER "*From Remodeling to Stroke, Vasculature to Cell: Unraveling the mechanics of sickle cell disease*" ($544K)
- (2024–29) co-PI: DOE ASCR Accelerated Research in Quantum Computing "*Achieving quantum utility in PDE solutions through particle-based representations*" ($9M, SHB share $1.13M)
- (2024–27) PI: DOD AFOSR YIP "*Actuator design and control in discontinuous flow fields*" ($450K)
- (2024–27) PI: DOD ONR YIP "*Systematic model improvement for reliably predictive simulations of flow-coupled solid-fuel jet engines*" ($750K)

4.2 Funded grants

- (2024–29) Senior personnel: DARPA Young Faculty Award "*Squid-inspired nozzles for enhanced efficiency and thrust in rotary propulsors*" ($1M), PI: S. Bhamla (GT), SHB Share: $150K Y1–2
- (2024–27) co-PI: DOD ONR N00014-24-1-2094 "*Multi-scale simulations of combustion in a solid propellant ramjet with embedded reactive metal particles*" ($375K), PI: S. Menon (GT), SHB Share: $125K
- (2024) PI: DOE DE-AC52-07NA27344 (Lawrence Livermore National Laboratories subcontract), "*Accelerated, Compressed, and Regularized Computation of Kinetic-based PDEs*" ($80K)
- (2023–28) co-PI: DOD ONR MURI N00014-23-1-2501, "*Combustion of solid fuels in high enthalpy flow*" ($3.8M) PI: G. Young (Virginia Polytechnic Institute and State University), 7 other co-PIs. SHB Share: $270K Y1–3

- (2023–27) PI: DOD ARO W911NF-23-10324, "*Investigation and inference of soft material deformation mechanisms unlocked at large speeds, finite deformations, and many cycles*," collaborative with University of Michigan, Jon Estrada. (Total: $835K; SHB Share: $314K)
- (2023–24) PI: DOE DE-NA0003525 (Sandia National Laboratories subcontract), "*Vibrated bubbly flow simulation*" ($100K)
- (2023–24) co-PI: DARPA HR0011-23-3-0006, "*Quantum eigensolvers in fluid-dynamic computations and applications*" ($300K), PI B. Gard (Georgia Tech Research Institute), SHB Share: $100K
- (2022–23) PI: DOE DE-NA0003525 (Sandia National Laboratories subcontract), "*Vibrated bubbly flow simulation*" ($65K)
- (2022–23) PI: DOE ORAU Powe, "*A methodologically coherent multi-scale model for multiphase flow*" ($10K)
- (2022–26) PI: DOD ONR N00014-22-12519, "*Stochastic framework for cavitating flows: mesoscale modeling and acceleration*" ($560K)
- (2022–23) co-PI: GTRI IRAD, "*Quantum optimization for lattice Boltzmann simulation (QOLBS)*" ($40K), PI: B. Gard (Georgia Tech Research Institute)
- (2022) PI: GT Seed Grant, Forming Teams "*Quantum computing for next-generation engineering simulation*" ($50K)
- (2022) PI: GTQA DE-0001321I, "*Quantum algorithms for lattice Boltzmann fluid flow simulation*" ($14.5K)

5 Publications

5.1 Preprints

[U4] Kocherla, S., A. Adams, Z. Song, A. Alexeev, and S. H. Bryngelson (2024). "A two-circuit approach to reducing quantum resources for the quantum lattice Boltzmann method". arXiv: 2401.12248. DOI: 10.48550/arXiv.2401.12248.

[U3] Song, Z., R. Deaton, B. Gard, and S. H. Bryngelson (2024). "Incompressible Navier–Stokes solve on noisy quantum hardware via a hybrid quantum–classical scheme". arXiv: 2406.00280. DOI: 10.48550/arXiv.2406.00280.

[U2] Chrit, F. E., S. Kocherla, B. Gard, E. F. Dumitrescu, A. Alexeev, and S. H. Bryngelson (2023). "Fully quantum algorithm for lattice Boltzmann methods with application to partial differential equations". arXiv: 2305.07148. DOI: 10.48550/arXiv.2305.07148.

[U1] Liu, J., F. Schäfer, S. H. Bryngelson, T. A. Zaki, and A. Mani (2023). "Targeted computation of nonlocal closure operators via an adjoint-based macroscopic forcing method". arXiv: 2310.08763. DOI: 10.48550/arXiv.2310.08763.

5.2 Archival, heavily refereed papers

[P24] Bati, A. and S. H. Bryngelson (2024). "RoseNNa: A performant, portable library for neural network inference with application to computational fluid dynamics". *Computer Physics Communications* **296**, 109052. DOI: 10.1016/j.cpc.2023.109052.

[P23] *Bryngelson, S. H., F. *Schäfer, J. Liu, and A. Mani (2024). "Fast Macroscopic Forcing Method". *Journal of Computational Physics* **499**. *Equal contribution, 112721. DOI: 10.1016/j.jcp.2023.112721.

[P22] Radhakrishnan, A., H. Le Berre, B. Wilfong, J.-S. Spratt, M. Rodriguez Jr., T. Colonius, and S. H. Bryngelson (2024). "Method for portable, scalable, and performant GPU-accelerated simulation of multiphase compressible flow". *Computer Physics Communications* **302**, 109238. DOI: 10.1016/j.cpc.2024.109238.

[P21] Sinha, A. and S. H. Bryngelson (2024). "Neural networks can be FLOP-efficient integrators of 1D oscillatory integrands". *Transactions on Machine Learning Research*. ISSN: 2835-8856.

[P20] Bryngelson, S. H., R. O. Fox, and T. Colonius (2023). "Conditional moment methods for polydisperse cavitating flows". *Journal of Computational Physics* **477**, 111917. DOI: 10.1016/j.jcp.2023.111917.

[P19] Elwasif, W., S. Bastrakov, S. H. Bryngelson, M. Bussmann, S. Chandrasekaran, F. Ciorba, M. A. Clark, A. Debus, W. Godoy, N. Hagerty, J. Hammond, D. Hardy, J. A. Harris, O. Hernandez, B. Joo, S. Keller, P. Kent, H. Le Berre, D. Lebrun-Grandie, E. MacCarthy, V. G. Melesse Vergara, B. Messer, R. Miller, S. Oral, J.-G. Piccinali, A. Radhakrishnan, O. Simsek, F. Spiga, K. Steiniger, J. Stephan, J. E. Stone, C. Trott, R. Widera, and J. Young (2023). "Early application experiences on a modern GPU-accelerated Arm-based HPC platform". *HPC Asia '23*. International Workshop on Arm-based HPC: Practice and Experience (IWAHPCE). Singapore. DOI: 10.1145/3581576.3581621.

[P18] Firouznia, M., S. H. Bryngelson, and D. Saintillan (2023). "A spectral boundary integral method for simulating electrohydrodynamic flows in viscous drops". *Journal of Computational Physics* **489**, 112248. DOI: 10.1016/j.jcp.2023.112248.

[P17] Panchal, A., S. H. Bryngelson, and S. Menon (2023). "A seven-equation diffused interface method for resolved multiphase flows". *Journal of Computational Physics* **475**, 111870. DOI: 10.1016/j.jcp.2022.111870.

[P16] Zeng, Q., Y. Kothari, S. H. Bryngelson, and F. Schäfer (2023). "Competitive physics informed networks". *International Conference on Learning Representations (ICLR)*. arXiv:2204.11144. Kigali, Rwanda.

[P15] Charalampopoulos, A., S. H. Bryngelson, T. Colonius, and T. P. Sapsis (2022). "Hybrid quadrature moment method for accurate and stable representation of non-Gaussian processes and their dynamics". *Philosophical Transactions of the Royal Society A* **380** 2229. DOI: 10.1098/rsta.2021.0209.

[P14] Bryngelson, S. H., K. Schmidmayer, V. Coralic, K. Maeda, J. Meng, and T. Colonius (2021). "MFC: An open-source high-order multi-component, multi-phase, and multi-scale compressible flow solver". *Computer Physics Communications* **266**, 107396. DOI: 10.1016/j.cpc.2020.107396.

[P13] Spratt, J.-S., M. Rodriguez, K. Schmidmayer, S. H. Bryngelson, J. Yang, C. Franck, and T. Colonius (2021). "Characterizing viscoelastic materials via ensemble-based data assimilation of bubble collapse observations". *Journal of the Mechanics and Physics of Solids* **152**, 104455. DOI: 10.1016/j.jmps.2021.104455.

[P12] Bryngelson, S. H., A. Charalampopoulos, T. P. Sapsis, and T. Colonius (2020). "A Gaussian moment method and its augmentation via LSTM recurrent neural networks for the statistics of cavitating bubble populations". *International Journal of Multiphase Flow* **127**, 103262. DOI: 10.1016/j.ijmultiphaseflow.2020.103262.

[P11] Bryngelson, S. H. and T. Colonius (2020). "Simulation of humpback whale bubble-net feeding models". *Journal of the Acoustical Society of America* **147** 2, 1126–1135. DOI: 10.1121/10.0000746.

[P10] Bryngelson, S. H., T. Colonius, and R. O. Fox (2020). "QBMMlib: A library of quadrature-based moment methods". *SoftwareX* **12**, 100615. DOI: 10.1016/j.softx.2020.100615.

[P9] Schmidmayer, K., S. H. Bryngelson, and T. Colonius (2020). "An assessment of multicomponent flow models and interface capturing schemes for spherical bubble dynamics". *Journal of Computational Physics* **402**, 109080. DOI: 10.1016/j.jcp.2019.109080.

[P8] Trummler, T., S. H. Bryngelson, K. Schmidmayer, S. J. Schmidt, T. Colonius, and N. A. Adams (2020). "Near-surface dynamics of a gas bubble collapsing above a crevice". *Journal of Fluid Mechanics* **899**, A16. DOI: 10.1017/jfm.2020.432.

[P7] Bryngelson, S. H. and J. B. Freund (2019). "Non-modal Floquet stability of a capsule in large amplitude oscillatory extension". *European Journal of Mechanics B/Fluids* **77**, 171–176. DOI: 10.1016/j.euromechflu.2019.04.012.

[P6] Bryngelson, S. H., F. Guéniat, and J. B. Freund (2019). "Irregular dynamics of cellular blood flow in a model microvessel". *Physical Review E* **100**, 012203. DOI: 10.1103/PhysRevE.100.012203.

[P5] Bryngelson, S. H., K. Schmidmayer, and T. Colonius (2019). "A quantitative comparison of phase-averaged models for bubbly, cavitating flows". *International Journal of Multiphase Flow* **115**, 137–143. DOI: 10.1016/j.ijmultiphaseflow.2019.03.028.

[P4] Bryngelson, S. H. and J. B. Freund (2018). "Floquet stability analysis of capsules in viscous shear flow". *Joural of Fluid Mechanics* **852**, 663–677. DOI: 10.1017/jfm.2018.574.

[P3] Bryngelson, S. H. and J. B. Freund (2018). "Global stability of flowing red blood cell trains". *Physical Review Fluids* **3** 7, 073101. DOI: 10.1103/PhysRevFluids.3.073101.

[P2] Bryngelson, S. H. and J. B. Freund (2016). "Buckling and its effect on the confined flow of a model capsule suspension". *Rheologica Acta* **55** 6, 451–464. DOI: 10.1007/s00397-015-0900-9.

[P1] Bryngelson, S. H. and J. B. Freund (2016). "Capsule-train stability". *Physical Review Fluids* **1** 3, 033201. DOI: 10.1103/PhysRevFluids.1.033201.