

# Spencer H. Bryngelson

## I Basic information

**Title:** Assistant Professor, School of Computational Science & Engineering

**Institution:** Georgia Institute of Technology

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## 2 Education

- University of Illinois at Urbana–Champaign
  - (2017) Doctor of Philosophy, Theoretical & Applied Mechanics
  - (2015) Master of Science, Theoretical & Applied Mechanics
  - (2015) Graduate Certificate, Computational Science & Engineering
- 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, College of Computing, 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
- (2017–18) Postdoctoral Researcher, XPACC (PSAAP II center), with Carlos Pantano, Dan Bodony, Jon Freund
- (2013–17) Graduate Research Fellow, University of Illinois at Urbana–Champaign, with Jon Freund
- (2015) Alumni Teaching Fellow, University of Illinois at Urbana–Champaign
- (2012–13) Undergraduate Research Assistant, University of Michigan–Dearborn, with Eric Ratts

## 4 Teaching

### 4.1 Georgia Institute of Technology

| Semester    | Number            | Course Title                          | Students |
|-------------|-------------------|---------------------------------------|----------|
| Spring 2023 | CSE6730           | Modeling & Simulation                 | 146      |
| Fall 2022   | VIP[2/3/4]60[1/2] | Team Phoenix Cluster Competition Team | 17       |
| Fall 2022   | CX/MATH4640       | Numerical Analysis I                  | 36       |
| Fall 2021   | CX/MATH4640       | Numerical Analysis I                  | 43       |

### 4.2 Other Institutions

| Semester    | Number | Course Title                                       | Students | Institute |
|-------------|--------|--|----------|-----------|
| Fall 2015   | ME310  | Fundamentals of Fluid Dynamics                     | 82       | Uillinois |
| Fall 2013   | ME3601 | Design and Analysis of Machine Elements            | 35       | UMichigan |
| Spring 2012 | ME364  | Probability, Statistics, and Reliability in Design | 32       | UMichigan |
| Fall 2012   | ME230  | Statics and Mechanics of Materials                 | 61       | UMichigan |

## 5 Students

### 5.1 Graduate

- Jesus Arias, Ph.D. student (CSE, co-advised with L. Sankar)
- Fatima Ezahra Chrit, Ph.D. student (ME and CSE, co-advised with A. Alexeev)
- Anand Radhakrishnan, Ph.D. student (CSE)
- Anshuman Sinha, M.S. student (CSE)
- Zhixin Song, Ph.D. Student (Physics)
- Benjamin Wilfong, Ph.D. student (CSE)
- Haocheng Yu, Ph.D. student (CSE, co-advised with K. Ahuja)

### 5.2 Undergraduate

- Ajay Bati (CS)
- Ansh Gupta (CS)
- Arjun Bhamra (CS)
- Sriharsha Kocherla (CS)
- Yash Kothari (CS)
- Henry Le Berre (CS)
- Qi Zeng (CS and Math, co-advised with F. Schäfer)

## 6 Awards

- (2022) Ralph E. Powe Junior Faculty Enhancement Award, Oak Ridge National Lab
- (2022–23) Georgia Tech Faculty Writing Scholar
- (2022–23) Class of 1969 Teaching Fellow, Georgia Institute of Technology
- (2017) Stanley Weiss Outstanding Dissertation Award, University of Illinois at Urbana–Champaign
- (2016) Hassan Aref Award (research in fluid mechanics), University of Illinois at Urbana–Champaign
- (2015) Alumni Teaching Fellowship, University of Illinois at Urbana–Champaign
- (2010–13) Dean’s List, University of Michigan–Dearborn
- (2011) Pi Tau Sigma (honor society, member), University of Michigan–Dearborn

## 7 Research support

### 7.1 Pending grants

- (2023–27) PI: ARO “*Investigation and inference of soft material deformation mechanisms unlocked at large speeds, finite deformations, and many cycles*” (\$550K)
- (2023–26) PI: NSF DARE “*Optimal computational model-based design of affordable wearable technology to monitor biomarkers in kids with enthesitis related arthritis*” (\$450K)
- (2023–26) co-PI: ONR “*Multi-scale simulations of combustion in a solid propellant ramjet with embedded reactive metal particles*” (\$375K)
- (2023–24) PI: Google Research Scholar Program “*Solving partial differential equations on noisy quantum processors*” (\$60K)
- (2023) PI: GT Seed Grant, Moving Teams Forward “*Quantum computing for next-generation engineering simulation*” (\$100K)

## 7.2 Funded grants

- (2023) PI: DOE/Sandia National Laboratory (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 N000142212519, “*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 (GTRI)
- (2022) PI: GT Seed Grant, Forming Teams “*Quantum computing for next-generation engineering simulation*” (\$50K)
- (2022) PI: GTQA DE00013211, “*Quantum algorithms for lattice Boltzmann fluid flow simulation*” (\$14.5K)

## 7.3 Travel grants

- (2023) SIAM CSE Travel Award
- (2023) APS FECS Travel Grant

## 7.4 Funded resource and hardware awards

- (2021–23) PI: Oak Ridge National Lab CFDI54, Director’s Discretionary, “*Accelerated sub-grid multi-component flow physics*” (20K node hours)
- (2022) PI: NVIDIA Academic Hardware Grant Program (4x BlueField-2 E-Series DPU, \$12K value)
- (2022) PI: Georgia Tech Tech. Fee “*ARM HPC Dev Kits for next-generation supercomputing*” (10 NVIDIA ARM HPC Dev. Kits, \$240K value)
- (2022) PI: AMD MI200-series GPU Server (\$77K value)
- (2022) PI: Stanford CTR Summer Program “*Fast macroscopic forcing for operator recovery via locality and causality with application to compressible and multiphase flow*” (\$8K, with F. Schäfer, SHB share \$4K)
- (2022) PI: NVIDIA Academic Hardware Grant Program (2x A100 80GB PCIe GPUs, \$30K value)
- (2021–22) PI: XSEDE TG-PHY210084, “*High-fidelity simulation of high-speed flowing dispersions via a stochastic sub-grid model*” (200K Node Hours, \$30K value)
- (2019–20) co-PI: XSEDE TG-CTS120005, “*Advanced immersed boundary and interface-capturing methods for simulations of complex flows*” (9M Node Hours, \$1.35M value)

## 8 Professional activity

### 8.1 Appointments and memberships

- (2021–Present) NATO Science & Technology Organization, Technical Team Member
- (2015–Present) Society of Industrial and Applied Mathematics, Member
- (2014–Present) American Physical Society, Member

### 8.2 Referee

- AIAA Journal
- Fluids
- IEEE International Parallel & Distributed Processing Symposium
- International Journal of Multiphase Flow
- International Journal of Offshore and Polar Engineering
- Journal of Computational Physics

- Journal of Fluid Mechanics
- Physical Review E
- Physical Review Fluids
- PLOS Computational Biology
- SIAM Scientific Computing
- Symposium of Naval Hydrodynamics
- Theoretical and Computational Fluid Dynamics

## 9 Service and outreach

### 9.1 Georgia Tech

#### 9.1.1 Institute-level

- (2021–Present) Georgia Tech *HPC Hackathon*, initiator and organizer, recruited sponsors Oak Ridge National Lab and NVIDIA
- (2022–Present) Georgia Tech *Scientific Software Engineering Center*, Advisory Board
- (2022–Present) PURA Award Reviewer
- (2022–Present) ORAU Powe Award Reviewer
- (2022) Faculty Search Panel, Professional Development Workshops, Georgia Tech Center for Teaching and Learning

#### 9.1.2 CoC-level

- (2022–Present) VIP Team Phoenix–Cluster Competition Team, Faculty advisor
- (2022–Present) CSE communication committee
- (2021–Present) TSO advisory committee representative
- (2021–Present) Seminar series organizer (with F. Schäfer and R. Vuduc)
- (2023) CRNCH Summit Panel organizer and moderator (with R. Vuduc)
- (2022) Organizer, Georgia Scientific Computing Symposium (with E. Chow and X. Zhang)
- (2022) Judge, CS Junior Design Capstone Expo
- (2021–22) Graduate student admissions committee

#### 9.1.3 Student examination committees

- (2023) Dissertation Proposal; Liana Hatoum (CoE BME)
- (2022) Ph.D. defense; Wangwei Lan (CoS Physics)
- (2022) Qualifying exam, Dissertation Proposal; Johnie Sublett (CoC CSE)
- (2022) Ph.D. defense; Achyut Panchal (CoE AE)
- (2021) Qualifying exam; Bradley Baker (CoC CSE)
- (2021) Qualifying exam; Conlain Kelly (CoC CSE)
- (2021) Qualifying exam; Sam Swanson (CoC CSE)

### 9.2 External

- (2021–Present) Mentor, GPU Hackathons (with Oak Ridge National Lab, NVIDIA, NASA)
- (2022) Supercomputing (SC) Mentor (via Mentor–Protege program)
- (2022) Supercomputing (SC) Early Career Program
- (2022) Panel Referee, ACCESS Maximize
- (2022) Grant Panel Reviewer, National Science Foundation

- (2021, 2022) Session chair, American Physical Society, Division of Fluid Dynamics
- (2021–22) Research mentor, XSEDE EMPOWER (Expert Mentoring Producing Opportunities for Work, Education, and Research; program received HPCwire 2021 Editors’ Choice Award in Workforce Diversity and Inclusion Leadership)
- (2021) Poster judge, American Physical Society, Division of Fluid Dynamics
- (2021) Mini-symposium organizer and session chair, “Machine learning for multiphase flows”, IACM Conference on Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering & Technology (MMLDT-CSET)
- (2020) Research mentor, Schmidt Academy for Software Engineering
- (2019) Research mentor, WAVE undergraduate research program for under-represented students, Caltech
- (2015–16) Judge, Illinois State-wide Math Competition
- (2014) Organizer, Science Night, Illinois Middle Schools

## 10 Publications

### 10.1 Preprints

- [U1] Firouznia, M., S. H. Bryngelson, and D. Saintillan (2022). “A spectral boundary integral method for simulating electrohydrodynamic flows in viscous drops”. arXiv: 2210.04957.

### 10.2 Journal articles

- [J17] 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](https://doi.org/10.1016/j.jcp.2023.111917).
- [J16] 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](https://doi.org/10.1016/j.jcp.2022.111870).
- [J15] 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](https://doi.org/10.1098/rsta.2021.0209).
- [J14] 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](https://doi.org/10.1016/j.cpc.2020.107396).
- [J13] 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](https://doi.org/10.1016/j.jmps.2021.104455).
- [J12] 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](https://doi.org/10.1016/j.ijmultiphaseflow.2020.103262).
- [J11] 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](https://doi.org/10.1121/10.0000746).
- [J10] 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](https://doi.org/10.1016/j.softx.2020.100615).

- [J9] 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](https://doi.org/10.1016/j.jcp.2019.109080).
- [J8] 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](https://doi.org/10.1017/jfm.2020.432).
- [J7] 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](https://doi.org/10.1016/j.euromechflu.2019.04.012).
- [J6] 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](https://doi.org/10.1103/PhysRevE.100.012203).
- [J5] 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](https://doi.org/10.1016/j.ijmultiphaseflow.2019.03.028).
- [J4] Bryngelson, S. H. and J. B. Freund (2018). “Floquet stability analysis of capsules in viscous shear flow”. *Journal of Fluid Mechanics* **852**, 663–677. DOI: [10.1017/jfm.2018.574](https://doi.org/10.1017/jfm.2018.574).
- [J3] 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](https://doi.org/10.1103/PhysRevFluids.3.073101).
- [J2] 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](https://doi.org/10.1007/s00397-015-0900-9).
- [J1] Bryngelson, S. H. and J. B. Freund (2016). “Capsule-train stability”. *Physical Review Fluids* **1** 3, 033201. DOI: [10.1103/PhysRevFluids.1.033201](https://doi.org/10.1103/PhysRevFluids.1.033201).

### 10.3 Refereed proceedings

- [P15] 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. Piccinalli, 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 Workshops: Proceedings of the HPC Asia 2023 Workshops*. International Workshop on Arm-based HPC: Practice and Experience (IWAHPCE). Singapore. DOI: [10.1145/3581576.3581621](https://doi.org/10.1145/3581576.3581621).
- [P14] Zeng, Q., Y. Kothari, S. H. Bryngelson, and F. Schäfer (2023). “Competitive physics informed networks”. *International Conference on Learning Representations (ICLR)*. Kigali, Rwanda.
- [P13] Bryngelson, S. H., A. Charalampopoulos, T. P. Sapsis, R. O. Fox, and T. Colonius (2022). “Representing statistics of dispersions via moment methods and recurrent neural networks with application to cavitating bubbles”. *34th Symposium on Naval Hydrodynamics*. Washington D.C., USA.
- [P12] Bryngelson, S. H., F. Schäfer, J. Liu, and A. Mani (2022). “Fast Macroscopic Forcing Method”. *Center for Turbulence Research, Proceedings of the Summer Program*. Stanford, CA, USA.
- [P11] Radhakrishnan, A., H. Le Berre, and S. H. Bryngelson (2022). “Scalable GPU accelerated simulation of multiphase compressible flow”. *The International Conference for High Performance Computing, Networking, Storage, and Analysis (SC)*. Dallas, TX, USA.
- [P10] Rodriguez, M., S. H. Bryngelson, and T. Colonius (2022). “Bubble dynamics with phase change near a compliant object”. *34th Symposium on Naval Hydrodynamics*. Washington D.C., USA.

- [P9] Bryngelson, S. H. and T. Colonius (2021). “Closure of phase-averaged bubbly, cavitating flow models”. *XXV International Congress of Theoretical and Applied Mechanics*. Milano, Italy. URL: <https://vimeo.com/640932583/0ae772bf00>.
- [P8] Bryngelson, S. H., F. O’Meally, T. Colonius, and R. O. Fox (2021). “Conditional moment method for fully-coupled phase-averaged cavitation models”. *11th International Symposium on Cavitation*. Daejeon, Korea. URL: <https://vimeo.com/640931949/a6cd12fc05>.
- [P7] Rodriguez, M., S. H. Bryngelson, S. Cao, and T. Colonius (2021). “A unified Eulerian multiphase framework for fluid-structure interaction problems including cavitation”. *XXV International Congress of Theoretical and Applied Mechanics*. Milano, Italy.
- [P6] Rodriguez, M., S. H. Bryngelson, S. Cao, and T. Colonius (2021). “Acoustically-induced bubble growth and phase change dynamics near compliant surfaces”. *11th International Symposium on Cavitation*. Daejeon, Korea.
- [P5] Spratt, J.-S., M. Rodriguez, S. H. Bryngelson, S. Cao, and T. Colonius (2021). “Eulerian framework for bubble-cloud-kidney stone interaction”. *11th International Symposium on Cavitation*. Daejeon, Korea.
- [P4] Bryngelson, S. H. and T. Colonius (2020). “Phase- and mixture-averaged techniques for general bubbly flows”. *33rd Symposium on Naval Hydrodynamics*. Osaka, Japan. URL: <https://vimeo.com/640930931/6e57ccfd89>.
- [P3] Bryngelson, S. H. and T. Colonius (2019). “A comparison of ensemble- and volume-averaged bubbly flow models”. *10th International Conference on Multiphase Flow*. Rio de Janeiro, Brazil.
- [P2] Bryngelson, S. H. and J. B. Freund (2016). “Buckling and the rheology of an elastic capsule suspension”. *XXIV International Congress of Theoretical and Applied Mechanics*. Montreal, Canada.
- [P1] Freund, J. B. and S. H. Bryngelson (2016). “The stability of flowing trains of confined red blood cells”. *XXIV International Congress of Theoretical and Applied Mechanics*. Montreal, Canada.

## 10.4 Other publications

- [O2] Bryngelson, S. H., C. Pantano, D. Bodony, and J. B. Freund (2018). *Adjoint-based sensitivity for flows with shocks*. Technical Report, XPACC.
- [O1] Bryngelson, S. H. (2017). “Stability and transition of capsule-flow systems”. Ph.D. Thesis. University of Illinois at Urbana–Champaign.

## II Talks

### II.1 Invited talks

- [I25] Lawrence Livermore National Laboratory, *Data-driven Physics Simulation Webinar* (2023). URL: <https://www.youtube.com/watch?v=zm-iF1FtkLE>.
- [I24] Arizona State University, *Fluids Seminar* (2022).
- [I23] Brown University, *Center for Fluid Mechanics, Applied Math and Engineering* (2022).
- [I22] CRNCH Summit (2022). URL: [https://mediaspace.gatech.edu/media/CRNCH+Summit+2022+-+Spencer+Bryngleson+-+Quantum+Computing+for+Continuum+Mechanics/1\\_23u8ou36](https://mediaspace.gatech.edu/media/CRNCH+Summit+2022+-+Spencer+Bryngleson+-+Quantum+Computing+for+Continuum+Mechanics/1_23u8ou36).
- [I21] Emory University, *Scientific Computing Seminar Series* (2022).
- [I20] Georgia Institute of Technology, *Aerospace Engineering School Seminar* (2022). URL: <https://vimeo.com/759713173/12ef9a0220>.



- [I19] Georgia Institute of Technology, *Applied and Computational Math Seminar Series* (2022).
- [I18] Georgia Scientific Computing Symposium (2022).
- [I17] Massachusetts Institute of Technology, *SAND Group* (2022).
- [I16] Office of Naval Research, *Basic Research Challenge Guest Talks* (2022).
- [I15] California Institute of Technology, *Mechanical and Civil Engineering Seminar Series* (2021).
- [I14] OpenACC Annual Summit (2021). URL: <https://youtu.be/DgX6ssX2yrg>.
- [I13] University of California, San Diego, *Fluid Mechanics, Combustion, & Engineering Physics Seminar Series* (2021). URL: <https://vimeo.com/640930056/b1a6c0dc62>.
- [I12] Georgia Institute of Technology, *Computational Science & Engineering Seminar Series* (2020).
- [I11] Massachusetts Institute of Technology, *SAND Group* (2019).
- [I10] University of Michigan–Ann Arbor, *Mechanical Engineering Seminar Series* (2019).
- [I9] University of Michigan–Dearborn, *Mechanical Engineering Seminar Series* (2019).
- [I8] University of Utah, *Mechanical Engineering Seminar Series* (2019).
- [I7] University of Vermont, *Mechanical Engineering Seminar Series* (2019).
- [I6] University of Washington, *Mechanical Engineering Seminar Series* (2019).
- [I5] California Institute of Technology, *Computational Flow Physics Group* (2018).
- [I4] California Institute of Technology, *Flow Mechanics Research Conference* (2018).
- [I3] ETH Zurich, *Computational Science & Engineering Lab* (2017).
- [I2] University of Illinois at Urbana–Champaign, *Fluid Mechanics Seminar* (2017).
- [I1] University of Illinois at Urbana–Champaign, *Biology Interest Group* (2015).

## II.2 Conference presentations

- [T42] Bryngelson, S. H., H. Le Berre, and A. Radhakrishnan (2023). “Compressible multiphase flow simulation at near-exascale via a scalable GPU implementation”. *American Physical Society, March Meeting*.
- [T41] Bryngelson, S. H., F. Schäfer, J. Liu, and A. Mani (2023). “Super-Spectral Operator Recovery via the Fast Macroscopic Forcing Method”. *SIAM Computational Science and Engineering*.
- [T40] Firouznia, M., S. H. Bryngelson, and D. Saintillan (2023). “A spectral boundary element method for interfacially driven flows”. *8th Micro and Nano Flows Conference*.
- [T39] Schäfer, F., A. Anandkumar, S. H. Bryngelson, Y. Kothari, H. Owhadi, Q. Zeng, and H. Zheng (2023). “Competitive Gradient Descent Algorithms”. *SIAM Computational Science and Engineering*.
- [T38] Arias, J. E. and S. H. Bryngelson (2022). “Radial-basis-function-based numerical methods for solving compressible flow equations at different Mach numbers”. *American Physical Society*.
- [T37] Bati, A. and S. H. Bryngelson (2022). “RoseNNA: A performant library for portable neural network inference with application to CFD”. *American Physical Society*.
- [T36] Bryngelson, S. H. (2022). “Fast integration methods for averaging bubble dynamics at sub-grid scales”. *19th U.S. National Congress on Theoretical and Applied Mechanics*.



- [T35] Bryngelson, S. H., F. Schäfer, J. Liu, and A. Mani (2022). “Fast Macroscopic Forcing: Exploiting locality for operator recovery”. *American Physical Society*.
- [T34] Chrit, F. E., S. Kocherla, A. Adams, J. Young, A. Alexeev, and S. H. Bryngelson (2022). “Quantum lattice algorithms for solving partial differential equations”. *17th Conference on Theory of Quantum Computation, Communication, and Cryptography*.
- [T33] Chrit, F. E., S. Kocherla, A. Alexeev, and S. H. Bryngelson (2022). “Quantum lattice gas algorithm for fluid flow simulations”. *American Physical Society*.
- [T32] Colonius, T. and S. H. Bryngelson (2022). “Hybrid quadrature moment methods for polydisperse cavitating flows”. *1st European–American–Japanese Two-Phase Flow Group Meeting*.
- [T31] Firouznia, M., S. H. Bryngelson, and D. Saintillan (2022). “A spectral boundary integral method for simulating electrohydrodynamic flows in liquid droplets”. *American Physical Society*.
- [T30] Panchal, A., A. Radhakrishnan, S. H. Bryngelson, and S. Menon (2022). “A numerical comparison of 5-, 6-, and 7-equation Baer-Nunziato-based diffuse interface methods”. *American Physical Society*.
- [T29] Radhakrishnan, A., H. Le Berre, and S. H. Bryngelson (2022). “Towards exascale multiphase compressible flow simulation via scalable interface capturing-based solvers and GPU acceleration”. *American Physical Society*.
- [T28] Rodriguez, M. and S. H. Bryngelson (2022). “Cavitation bubble growth near an elastic object”. *American Physical Society*.
- [T27] Rodriguez, M., S. H. Bryngelson, and T. Colonius (2022). “Numerical simulations of cavitation near an elastic object”. *ECCOMAS Congress*.
- [T26] Rodriguez, M., J.-S. Spratt, S. H. Bryngelson, and T. Colonius (2022). “Numerical simulations of cavitation bubble growth and collapse near a viscoelastic object”. *19th U.S. National Congress on Theoretical and Applied Mechanics*.
- [T25] Spratt, J., M. Rodriguez, S. H. Bryngelson, and T. Colonius (2022). “Numerical simulations of ablation mechanisms during focused ultrasound therapies”. *American Physical Society*.
- [T24] Zeng, Q., S. H. Bryngelson, and F. Schäfer (2022). “Competitive physics informed networks”. *ICLR workshop “Gamification and Multiagent Solutions”*.
- [T23] Bryngelson, S. H., A. Charalampopoulos, R. O. Fox, T. Sapsis, and T. Colonius (2021). “Bypassing quadrature moment method instability via recurrent neural networks with application to cavitating bubble dispersions”. *American Physical Society*. URL: <https://vimeo.com/650700675/06006b48de>.
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### II.3 Software

Our software is located at [github.com/comp-physics](https://github.com/comp-physics), below is an autogenerated listing:

| Name (click for Github repo.)               | Description   |
|---|---|
| <a href="#">awesome-modeling-simulation</a> | Resources for learning about modeling and simulation  |
| <a href="#">CPINN</a>                       | Competitive Physics Informed Networks   |
| <a href="#">RBC3D</a>                       | 3D Spectral boundary integral solver for cell-scale blood flow  |
| <a href="#">roseNNa</a>                     | A fast and minimally-intrusive neural network inference library   |
| <a href="#">hip-stencil-code</a>            | Stencil code for AMD GPUs   |
| <a href="#">awesome-numerics</a>            | Resources for learning about numerical methods.   |
| <a href="#">RBC2D</a>                       | 2D Spectral boundary integral solver for cell-scale blood flow  |
| <a href="#">QBMMlib</a>                     | Mathematica package for quadrature-based moment methods and population balance equations.                 |
| <a href="#">PyQBMMlib</a>                   | PyQBMMlib is a Python extension of QBMMlib.   |
| <a href="#">PyCav</a>                       | Dynamics of cavitating bubble populations   |
| <a href="#">bubble-dynamics-resnet</a>      | Integrate bubble dynamics faster!   |
| <a href="#">tensor-modal-decomp</a>         | modal decomposition via high-order statistics for people  |
| <a href="#">fvm-risc</a>                    | Benchmarking FVMs on different hardware and under different optimizations                                 |
| <a href="#">IMR</a>                         | Inertial Microcavitation Rheometry  |
| <a href="#">WENO-scalar</a>                 | A WENO solver for 1D scalar PDEs  |
| <a href="#">WENO-NN</a>                     | A modified WENO method that improves interface sharpness via neural networks.                             |
| <a href="#">ECOGEN-CIT</a>                  | A version of ECOGEN that was developed and used at Caltech  |
| <a href="#">EnsAvg-1D-Tait</a>              | 1D Ensemble-averaging solver for dilute cavitating bubbly flows. Finite volume with WENO/Riemann solvers. |
| <a href="#">1D-Shocks-Adjoint</a>           | A shock-capturing adjoint solver for the compressible flow equations                                      |
| <a href="#">capillary-instability</a>       | A solver for the eigenmodes of an unstable viscoelastic jet   |
| <a href="#">sphererepack-doc</a>            | Additional documentation for SPHEREPACK   |

We maintain [MFC](#), an exascale-ready multiphase CFD solver:

| Name (click for Github repo.) | Description                              |
|-------------------------------|--|
| <a href="#">MFC</a>           | High-fidelity multiphase flow simulation |
| <a href="#">MicroFC</a>       | A micro MFC and CFD mini-app             |
| <a href="#">MFC-develop</a>   | Development repo. for MFC                |

We also work on Inertial Microcavitation Rheometry (IMR) software:

| Name (click for Github repo.)         | Description  |
|---------------------------------------|--|
| <a href="#">IMR-simple</a>            | MATLAB simple codes to numerically simulate laser/ultrasound-induced inertial cavitation bubble dynamics in soft materials |
| <a href="#">IMR-data-assimilation</a> | IMR with Data Assimilation   |
| <a href="#">IMR-v1</a>                | Vanilla IMR codebase   |
| <a href="#">inca</a>                  | InertialCav supported by J. Estrada's group  |