Spencer H. Bryngelson

1 Basic information

- Title: Assistant Professor, School of Computational Science & Engineering
- Institution: Georgia Institute of Technology
- Address: S1313 CODA, 756 W Peachtree St NW, Atlanta, GA 30308
- Email: shb@gatech.edu
- Website: https://comp-physics.group

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 Research positions

- (2021–Present) Assistant Professor, School of Computational Science & Engineering, College of Computing, Georgia Institute of Technology
- (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
- (2012–13) Undergraduate Research Assistant, University of Michigan–Dearborn, with Eric Ratts

4 Teaching

- (2021) CX4640/MATH4640 Numerical Analysis I, Georgia Institute of Technology
- (2015) ME310 Fundamentals of Fluid Dynamics, University of Illinois at Urbana–Champaign
- (2013) ME3601 Design and Analysis of Machine Elements, University of Michigan–Dearborn
- (2012) ME364 Probability, Statistics, and Reliability in Design, University of Michigan–Dearborn
- (2012) ME230 Statics and Mechanics of Materials, University of Michigan–Dearborn

5 Students

5.1 Current

5.1.1 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 (CS)
- Scott Sims, M.S. student (CSE)

5.1.2 Undergraduate

- Girish Ganesan, Rutgers University (via XSEDE EMPOWER)
- Sriharsha Kocherla (jointly-enrolled high school student)
- Henry Le Berre (CS)
- Qi Zeng (CS and Math, co-advised with F. Schäfer)

5.1.3 Non-Georgia-Tech affiliates

- Alexis Charalampopoulos, Ph.D. student, Massachusetts Institute of Technology (Primary advisor: T. Sapsis)
- Jose Chreim, Ph.D. student, California Institute of Technology (Primary advisor: T. Colonius)
- Jean-Sebastien Spratt, Ph.D. student, California Institute of Technology (Primary advisor: T. Colonius)

5.2 Alumni

- Ben Stevens, California Institute of Technology, Ph.D. (2021), Primary advisor: T. Colonius
- David Mittelstein, California Institute of Technology, Ph.D. (2020), Primary advisor: M. Shapiro
- Franz O'Meally, Johns Hopkins University, B.S. (2020)
- Theresa Trummler, TU Munich, Ph.D. (2020), Primary advisor: N. Adams
- Qifan Wang, California Institute of Technology, B.S. (2020)

6 Awards

- (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 Grants

7.1 Funded grants and allocations

- (2022) PI: GTQA DE00013211, "*Quantum algorithms for lattice Boltzmann fluid flow simulation*" ($14.5K)
- (2021–22) PI: XSEDE TG-PHY210084, "*High-fidelity simulation of high-speed flowing dispersions via a stochastic sub-grid model*" (allocation, 200K Node Hours, $30K value)
- (2021–22) PI: Oak Ridge National Lab CFD154, Director's Discretionary, "*Accelerated sub-grid multi-component flow physics*" (allocation, 10K Node Hours)
- (2019–20) co-PI: XSEDE TG-CTS120005, "*Advanced immersed boundary and interface-capturing methods for simulations of complex flows*" (allocation, 9M Node Hours, $1.35M value)

7.2 Supported grants

- (2019–21) NIH 2P01-DK04881, with T. Colonius
- (2018–21) ONR MURI N0014-17-1-2676, with T. Colonius
- (2018–21) ONR BRC N0014-17-1-2625, with T. Colonius
- (2017–18) DOE PSAAP DE-NA0002374, with J. B. Freund and W. Gropp
- (2013–17) NSF CBET 13-36972, with J. B. Freund

8 Professional activity

8.1 Referee

- AIAA Journal
- Fluids
- International Journal of Multiphase Flow
- Journal of Computational Physics
- Journal of Fluid Mechanics
- Theoretical and Computational Fluid Dynamics

8.2 Appointments and memberships

- (2021–22) NATO Science & Technology Organization, Technical Team Member
- (2015–Present) Society of Industrial and Applied Mathematics, Member
- (2014–Present) American Physical Society, Member

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

9.1.2 CoC CSE school-level

- (2022) Co-organizer, Georgia Scientific Computing Symposium (with E. Chow and X. Zhang)
- (2021–Present) TSO advisory committee representative
- (2021–Present) Seminar series organizer (with F. Schäfer and Rich Vuduc)
- (2021) Graduate student admissions committee

9.1.3 Student examination committees

- (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) Research mentor, XSEDE EMPOWER (Expert Mentoring Producing Opportunities for Work, Education, and Research; program recieved HPCwire 2021 Editors' Choice Award in Workforce Diversity and Inclusion Leadership)
- (2021) Mentor, OpenACC GPU Hackathon (with Oak Ridge National Lab and Nvidia)
- (2021) Poster judge, American Physical Society, Division of Fluid Dynamics
- (2021) Session chair, 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

[P1] Charalampopoulos, A., **Bryngelson, S. H.**, Colonius, T., Sapsis, T. P., (2021). "Hybrid quadrature moment method for accurate and stable representation of non-Gaussian processes and their dynamics". arXiv: 2110.01374.

10.2 Journal papers

[J14] **Bryngelson, S. H.**, Schmidmayer, K., Coralic, V., Maeda, K., Meng, J., Colonius, T., (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.

[J13] Spratt, J.-S., Rodriguez, M., Schmidmayer, K., **Bryngelson, S. H.**, Yang, J., Franck, C., Colonius, T., (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.

[J12] **Bryngelson, S. H.**, Charalampopoulos, A., Sapsis, T. P., Colonius, T., (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.

[J11] **Bryngelson, S. H.**, Colonius, T., (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.

[J10] **Bryngelson, S. H.**, Colonius, T., Fox, R. O., (2020). "QBMMlib: A library of quadrature-based moment methods". *SoftwareX* **12**, 100615. DOI: 10.1016/j.softx.2020.100615.

[J9] Schmidmayer, K., **Bryngelson, S. H.**, Colonius, T., (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.

[J8] Trummler, T., **Bryngelson, S. H.**, Schmidmayer, K., Schmidt, S. J., Colonius, T., Adams, N. A., (2020). "Near-surface dynamics of a gas bubble collapsing above a crevice". *Journal of Fluid Mechanics* **899**, A16. DOI: 10.1017/jfm.2020.432.

[J7] **Bryngelson, S. H.**, Freund, J. B., (2019). "Non-modal Floquet stability of a capsule in large amplitude oscillatory extension". *European Journal of Mechanics B* **77**, 171–176. DOI: 10.1016/j.euromechflu.2019.04.012.

[J6] **Bryngelson, S. H.**, Guéniat, F., Freund, J. B., (2019). "Irregular dynamics of cellular blood flow in a model microvessel". *Physical Review E* **100**, 012203. DOI: 10.1103/PhysRevE.100.012203.

[J5] **Bryngelson, S. H.**, Schmidmayer, K., Colonius, T., (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.

[J4] **Bryngelson, S. H.**, Freund, J. B., (2018). "Floquet stability analysis of capsules in viscous shear flow". *Joural of Fluid Mechanics* **852**, 663–677. DOI: 10.1017/jfm.2018.574.

[J3] **Bryngelson, S. H.**, Freund, J. B., (2018). "Global stability of flowing red blood cell trains". *Physical Review Fluids* **3** 7, 073101. DOI: 10.1103/PhysRevFluids.3.073101.

[J2] **Bryngelson, S. H.**, Freund, J. B., (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.

[J1] **Bryngelson, S. H.**, Freund, J. B., (2016). "Capsule-train stability". *Physical Review Fluids* **1** 3, 033201. DOI: 10.1103/PhysRevFluids.1.033201.

10.3 Refereed proceedings

[C9] **Bryngelson, S. H.**, Colonius, T., (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.

[C8] **Bryngelson, S. H.**, O'Meally, F., Colonius, T., Fox, R. O., (2021). "Conditional moment method for fully-coupled phase-averaged cavitation models". *11th International Symposium on Cavitation*. Daejeon, Korea. URL: https://vimeo.com/640931949/a6cd12fc05.

[C7] Rodriguez, M., **Bryngelson, S. H.**, Cao, S., Colonius, T., (2021). "A unified Eulerian multiphase framework for fluid-structure interaction problems including cavitation". *XXV International Congress of Theoretical and Applied Mechanics*. Milano, Italy.

[C6] Rodriguez, M., **Bryngelson, S. H.**, Cao, S., Colonius, T., (2021). "Acoustically-induced bubble growth and phase change dynamics near compliant surfaces". *11th International Symposium on Cavitation*. Daejeon, Korea.

[C5] Spratt, J.-S., Rodriguez, M., **Bryngelson, S. H.**, Cao, S., Colonius, T., (2021). "Eulerian framework for bubble-cloud-kidney stone interaction". *11th International Symposium on Cavitation*. Daejeon, Korea.

[C4] **Bryngelson, S. H.**, Colonius, T., (2020). "Phase- and mixture-averaged techniques for general bubbly flows". *33rd Symposium on Naval Hydrodynamics*. Osaka, Japan. URL: https://vimeo.com/640930931/6e57ccfd89.

[C3] **Bryngelson, S. H.**, Colonius, T., (2019). "A comparison of ensemble- and volume-averaged bubbly flow models". *10th International Conference on Multiphase Flow*. Rio de Janeiro, Brazil.

[C2] **Bryngelson, S. H.**, Freund, J. B., (2016). "Buckling and the rheology of an elastic capsule suspension". *XXIV International Congress of Theoretical and Applied Mechanics*. Montreal, Canada.

[C1] Freund, J. B., **Bryngelson, S. H.,** (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.**, Pantano, C., Bodony, D., Freund, J. B., (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.

11 Talks

11.1 Invited talks

[I15] **Bryngelson, S. H.** (2021). *OpenACC Annual Summit*. URL: https://youtu.be/DgX6ssX2yrg.

[I14] **Bryngelson, S. H.** (2021). *University of California, San Diego*. Fluid Mechanics, Combustion, & Engineering Physics Seminar Series. URL: https://vimeo.com/640930056/b1a6c0dc62.

[I13] **Bryngelson, S. H.** (2021). *California Institute of Technology*. Mechanical and Civil Engineering Seminar Series.

[I12] **Bryngelson, S. H.** (2020). *Georgia Institute of Technology*. Computational Science & Engineering Seminar Series.

[I11] **Bryngelson, S. H.** (2019). *University of Washington*. Mechanical Engineering Seminar Series.

[I10] **Bryngelson, S. H.** (2019). *University of Michigan-Ann Arbor*. Mechanical Engineering Seminar Series.

[I9] **Bryngelson, S. H.** (2019). *Massachusetts Institute of Technology*. Mechanical Engineering.

[I8] **Bryngelson, S. H.** (2019). *University of Vermont*. Mechanical Engineering Seminar Series.

[I7] **Bryngelson, S. H.** (2019). *University of Utah*. Mechanical Engineering Seminar Series.

[I6] **Bryngelson, S. H.** (2019). *University of Michigan-Dearborn*. Mechanical Engineering Seminar Series.

[I5] **Bryngelson, S. H.** (2018). *California Institute of Technology*. Flow Mechanics Research Conference.

[I4] **Bryngelson, S. H.** (2018). *California Institute of Technology*. Computational Flow Physics Group.

[I3] **Bryngelson, S. H.** (2017). *ETH Zurich*. Computational Science & Engineering Lab.

[I2] **Bryngelson, S. H.** (2017). *University of Illinois at Urbana-Champaign*. Fluid Mechanics Seminar.

[I1] **Bryngelson, S. H.** (2015). *University of Illinois at Urbana-Champaign*. Biology Interest Group.

11.2 Conference talks

[T23] **Bryngelson, S. H.**, Charalampopoulos, A., Fox, R. O., Sapsis, T., Colonius, T., (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.

[T22] **Bryngelson, S. H.**, Charalampopoulos, A., Sapsis, T., Colonius, T., (2021). "Machine learned model for non-Gaussian cavitation statistics". *International Association for Computational Mechanics MMLDT-CSET*.

[T21] **Bryngelson, S. H.**, Colonius, T., (2021). "Statistical model for cavitating polydisperse bubble clouds". *Journal of the Acoustical Society of America*. URL: https://vimeo.com/640933361/4f9d1469ce.

[T20] **Bryngelson, S. H.**, Colonius, T., (2021). "Sub-grid population balance model for cavitating flows". *14th Southern California Flow Physics Symposium*.

[T19] **Bryngelson, S. H.**, Wang, Q., Cisneros-Garibay, E., Colonius, T., (2021). "GPU-accelerated quadrature moment methods". *SIAM Annual Meeting*.

[T18] Rodriguez, M., **Bryngelson, S. H.**, Colonius, T., (2021). "Acoustically induced bubble growth with phase change". *14th Southern California Flow Physics Symposium*.

[T17] Rodriguez, M., **Bryngelson, S. H.**, Colonius, T., (2021). "Vapor and gas bubble growth with phase transition near a wall". *American Physical Society*.

[T16] Spratt, J.-S., Rodriguez, M., **Bryngelson, S. H.**, Cao, S., Colonius, T., (2021). "High fidelity single framework simulations of acoustic wave–bubble cloud–elastic solid interactions". *American Physical Society*.

[T15] Spratt, J.-S., Rodriguez, M., **Bryngelson, S. H.**, Cao, S., Colonius, T., (2021). "Numerical Simulations of burst-wave lithotripsy in an Eulerian framework". *14th Southern California Flow Physics Symposium*.

[T14] Spratt, J.-S., Rodriguez, M., **Bryngelson, S. H.**, Cao, S., Colonius, T., (2021). "Single-framework simulations of acoustic-wave–bubble cloud–stone interactions". *Journal of the Acoustical Society of America*.

[T13] **Bryngelson, S. H.**, Fox, R., Colonius, T., (2020). "Conditioned quadrature moment methods for cavitating bubble dispersions". *American Physical Society*. URL: https://vimeo.com/640933407/2830fcf3e0.

[T12] Rodriguez, M., **Bryngelson, S. H.**, Colonius, T., (2020). "Cavitation bubble growth with phase transition near a rigid wall". *American Physical Society*.

[T11] Spratt, J.-S., Rodriguez, M., **Bryngelson, S. H.**, Colonius, T., (2020). "A fully Eulerian simulation framework for cavitating bubble-clouds near viscoelastic materials". *American Physical Society*.

[T10] **Bryngelson, S. H.**, Charalampopoulos, A., Sapsis, T. P., Colonius, T., (2019). "Neural-network-augmented Gaussian moment method for the statistics of cavitating bubble populations". *American Physical Society*.

[T9] **Bryngelson, S. H.**, Colonius, T., (2019). "Annular and spiral bubble nets: A simulation-focused analysis of humpback whale feeding strategies". *Journal of the Acoustical Society of America, 146(4) 2771*.

[T8] **Bryngelson, S. H.**, Colonius, T., (2019). "Simulations and acoustics of humpback whale bubble-net feeding". *13th Southern California Flow Physics Symposium*.

[T7] Trummler, T., Schmidmayer, K., **Bryngelson, S. H.**, Colonius, T., (2019). "Simulations of a collapsing gas bubble above a crevice". *13th Southern California Flow Physics Symposium*.

[T6] **Bryngelson, S. H.**, Colonius, T., (2018). "Modeling approaches for bubbly, cavitating flows". *American Physical Society*.

[T5] **Bryngelson, S. H.**, Freund, J. B., (2017). "Floquet stability of tank-treading and tumbling capsules in viscous shear flow". *American Physical Society*.

[T4] **Bryngelson, S. H.**, Freund, J. B., (2017). "Global stability of fully coupled capsule flow systems". *SIAM Computational Science and Engineering*.

[T3] **Bryngelson, S. H.**, Freund, J. B., (2017). "Stability of flowing red blood cell trains". *Blood Flow*.

[T2] **Bryngelson, S. H.**, Freund, J. B., (2016). "Stability and transition to chaos of regular capsule trains". *American Physical Society*.

[T1] **Bryngelson, S. H.**, Freund, J. B., (2015). "Buckling and its effect on the confined flow of a capsule suspension". *American Physical Society*.

12 Software

[S5] **Bryngelson, S. H.**, Cisneros-Garibay, E., Wang, Q., Fox, R. O., Colonius, T., (2020). *PyQBMMlib: A library of quadrature-based moment methods*. URL: https://github.com/comp-physics/PyQBMMlib.

[S4] **Bryngelson, S. H.**, Fox, R. O., Colonius, T., (2020). *QBMMlib: A library of quadrature-based moment methods*. URL: https://github.com/comp-physics/QBMMlib.

[S3] **Bryngelson, S. H.**, Radhakrishnan, A., Rodriguez, M., Spratt, J.-S., Schmidmayer, K., Coralic, V., Maeda, K., Meng, J., Colonius, T., (2019). *MFC: Multi-component Flow Code*. URL: https://mflowcode.github.io.

[S2] Schmidmayer, K., Dorschner, B., Daniel, E., Martelot, S. L., **Bryngelson, S. H.**, Petitpas, F., (2019). *ECOGEN: Multiphase and capillary flow solver*. URL: https://code-mphi.github.io/ECOGEN/.

[S1] Campbell, M., Cisneros, E., **Bryngelson, S. H.**, Buchta, D., Anderson, M., Diener, M., Smith, M., (2018). *PlasCom2: Multi-physics turbulent flows*. URL: https://xpacc-dev.bitbucket.io/PlasCom2/.