Jeremy Binagia

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ABOUT ME

Engineer with an expertise in computational modeling and high-performance computing interested in solving complex problems using applied mathematics, numerical simulation, and machine learning

EDUCATION

Stanford University, Ph.D. in Chemical Engineering (4.068 GPA) — Expected June 2022
Stanford University, M.S. in Chemical Engineering (4.068 GPA) — 2019
The University of Texas at Austin, B.S. in Chemical Engineering with Highest Honors (4.00 GPA) — 2016

RESEARCH EXPERIENCE

Graduate Researcher, Stanford University — 2016 – Present
Advisor: Prof. Eric S.G. Shaqfeh

- Designs and writes algorithms from scratch in Fortran to simulate problems involving fluid-structure interaction
- Optimizes and debugs programs written in a low-level language to leverage distributed parallel computing via MPI
- Collaborates with others to design, test, and enhance the group's massively parallel multiphysics flow solver
- Visualizes and analyzes large computational fluid dynamics (CFD) datasets using Python, Matlab, and Tecplot
- Created first fully resolved 3D simulation of microorganisms swimming in complex biological fluids
- Currently leading an interdisciplinary effort with researchers in mechanical engineering to create a robotic "swimming rheometer" that can be used to infer the fluid properties of complex biofluids

High-Energy-Density Physics Intern, Lawrence Livermore National Laboratory — 2020
Mentor: Dr. Luc Peterson

- Conducted radiation hydrodynamics simulations to assess the impact of ablator microstructure on seeding fluid instabilities within inertial confinement fusion (ICF) experiments conducted at the National Ignition Facility (NIF)
- Developed an image processing workflow to infer material microstructure from SEM images of ICF capsules

Undergraduate Researcher, The University of Texas at Austin — 2015 – 2016
Advisor: Prof. Roger T. Bonnecaze

- Prototyped a novel nano-patterning method involving selective reduction of a metal oxide film using COMSOL
- Utilized molecular dynamics (MD) simulations to compute rheological properties of soft particle glasses

Undergraduate Researcher, Purdue University — 2014
Advisor: Prof. Doraiswami Ramkrishna

- Modeled the signaling network bacterial populations use to regulate the transfer of antibiotic resistance through a coupled system of partial differential equations (PDEs)
- Performed stochastic simulations of various chemical systems using a parallel tau-leaping algorithm

TEACHING & MENTORING EXPERIENCE

Teaching Assistant, Stanford University — 2017 – 2018
Applied Math. in the Chemical and Biological Sciences (CHEMENG 300), Prof. Andrew Spakowitz

- Planned and led weekly recitation sessions, gave assignment feedback, and provided final project guidance to 30+ students
- Awarded a 2019 Chemical Engineering Outstanding Teaching Assistant Award

Graduate Mentor, Stanford University — 2019

- Taught a visiting undergraduate student the fundamentals of biological fluid dynamics and how to setup, run, and analyze computational fluid dynamics simulations as part of the Stanford Amgen Scholars Program

SKILLS

Languages (experienced & familiar): Python, C++, MATLAB, Fortran, Lua, R, Mathematica
Software (experienced & familiar): Linux, Git, Pandas, NumPy, MPI, CUDA, COMSOL, PyTorch, TensorFlow, OpenMP
Theory: Fluid mechanics, Transport phenomena, Parallel computing, Machine learning

SELECTED AWARDS & HONORS

Gerald J. Liebermann Fellowship (*awarded to ~13 outstanding Stanford PhD students annually*) — 2021 – 2022
National Science Foundation (NSF) Graduate Research Fellowship (*fund 3 years, valued at $140,000*) — 2016 – 2019
National Defense Science & Engineering Graduate (NDSEG) Fellowship Awardee (*5-10% acceptance rate*) — 2016

LEADERSHIP & SERVICE

Chair, Dean's Graduate Student Advisory Council (DGSAC)	2021 – 2022
Peer Reviewer, *Journal of Fluid Mechanics*	2021
Program Coordinator, Science Teaching Through Art (STAR)	2019 – 2021
Instructor, Stanford Prison Education Project (SPEP)	2019 – 2021
Member, Stanford CHEMENG Faculty Search Committee	2019 – 2021
Member, Graduate Student Action Committee (GSAC) Professional Development Subcommittee	2019 – 2020

RELEVANT GRADUATE COURSEWORK

Fluid mechanics:	Microhydrodynamics, Suspension mechanics, Flow instability, Complex fluids and non-Newtonian flows, Physics of microfluidics
Computational science:	Numerical methods, Linear algebra, Finite element analysis, Algorithmic analysis, Parallel computing, Advanced software development, Cardiovascular computational modeling
Machine learning:	Data mining and analysis, Deep learning, Machine learning in computational engineering

MACHINE LEARNING PROJECTS

Teaching Microswimmers How to Navigate via Reinforcement Learning (github.com/jbinagia/cme216-final-project) 2020

- Trained active particles to navigate a complex flow field via reinforcement learning (Q-learning, expected SARSA)

Parallel Neural Network Training using Multiple GPUs (github.com/jbinagia/cme213-final-project) 2020

- Designed a parallel algorithm to accelerate neural network training on multiple GPUs via CUDA and MPI

Efficient Sampling of Equilibrium States Using Artificial Neural Networks (github.com/jbinagia/CS-230-Final-Project) 2020

- Implemented a deep neural network in PyTorch that learns latent space descriptions of molecular configurations

PUBLICATIONS

1. Jain, A., Zhang, A., **Binagia, J. P.,** Shaqfeh, E. S. G. Particle suspensions in viscoelastic fluids: freely suspended, passive and active matter. *Invited book chapter to be published in the Journal of Rheology.*
2. **Binagia, J. P.,** & Shaqfeh, E. S. G. Self-propulsion of a freely suspended swimmer by a swirling tail in a viscoelastic fluid. *Physical Review Fluids* (2021).
   - Selected as an Editor's Suggestion and featured in a Synopsis article in the magazine "Physics"
3. Housiadas, K. D., **Binagia, J. P.**, & Shaqfeh, E. S. G. Squirmers with swirl in viscoelastic fluids at low Weissenberg number. *Journal of Fluid Mechanics* (2021).
4. **Binagia, J. P**., Phoa, A., Housiadas, K. D. & Shaqfeh, E. S. G. Swimming with swirl in a viscoelastic fluid. *Journal of Fluid Mechanics* (2020).
5. **Binagia, J. P.*,** Guido, C. J.*, Shaqfeh, E. S. G. Three-dimensional simulations of undulatory and amoeboid swimmers in viscoelastic fluids. *Soft Matter* (2019).
6. Shu, C.-C., Tran, V., **Binagia, J.**, Ramkrishna, D. On speeding up stochastic simulations by parallelization of random number generation. *Chemical Engineering Science* (2015).

PATENTS

1. Bonnecaze, R., Chopra, M., Chopra, S., **Binagia, J.**, Ekerdt, J., & Edmondson, B. Patterning metal regions on metal oxide films/metal films by selective reduction/oxidation using localized thermal heating (2020). U.S. Patent App. No. 16/467,927.

CONFERENCE ORAL PRESENTATIONS

1. **Binagia, J. P.**, Phoa, A., Housiadis, K., & Shaqfeh, E. S. G. The impact of azimuthal flow on swimming dynamics in elastic fluids. *18th International Congress on Rheology (ICR).* Virtual Meeting (Dec. 2020).
2. **Binagia, J. P.**, Phoa, A., Housiadis, K., & Shaqfeh, E. S. G. Swimming with swirl at low Weissenberg number. *APS Division of Fluid Dynamics*. Virtual Meeting (Nov. 2020).
3. **Binagia, J. P.**, & Shaqfeh, E. S. G. Swimming with swirl in a viscoelastic fluid. *American Institute of Chemical Engineers (AIChE) Annual Meeting.* Virtual Meeting (Nov. 2020). Video link: https://youtu.be/STR7URrmcPc
4. **Binagia, J. P.**, & Shaqfeh, E. S. G. Swimming with swirl in a viscoelastic fluid. *Society of Engineering Science*. Virtual Meeting (Sep. 2020).
5. **Binagia, J. P.**, Phoa, A., Housiadis, K., & Shaqfeh, E. S. G. How azimuthal swirl impacts swimming kinematics in a viscoelastic fluid. *APS Division of Fluid Dynamics.* Seattle, WA (2019, Nov).
6. **Binagia, J. P.**, Guido, C. J., & Shaqfeh, E. S. G. Simulating the swimming motion of *C. elegans* and amoeboids in viscoelastic fluids via the immersed boundary method. *SIAM Conference on Computational Science and Engineering*. Spokane, WA (Feb. 2019).

* *These authors contributed equally*