James Gabbard

63-1 St Germain Street
Boston, MA 02115

jgabbard@mit.edu | (408) 722-6164 | mit.edu/~jgabbard

I am an MIT PhD student studying computational fluid dynamics and high-performance computing, with coursework in scientific machine learning, statistical inference, and uncertainty quantification. I am looking for full time in-person or hybrid research positions in the Seattle area starting in Fall 2024.

EDUCATION

Massachusetts Institute of Technology — Boston, MA
Candidate for PhD in Mechanical Engineering and Computation — Expected 2024
SM in Mechanical Engineering — Feb. 2020
Cumulative GPA: 5.0/5.0

University of Southern California — Los Angeles, CA
B.S. Mechanical Engineering and B.S. Applied and Computational Mathematics — May 2018
Cumulative GPA: 3.99/4.00

RESEARCH PROJECTS

Immersed Interface methods for Tightly Coupled Multiphysics Simulations — Ongoing
Graduate Research Assistant, MIT Van Rees Lab
- Developed high-order finite difference methods for 3D simulations with immersed interfaces
- Implemented these numerical methods in a C++-based distributed-memory simulation framework.
- Analyzed the performance and accuracy of this framework in simulations using over 2000 CPUs.

An Embedded Boundary Space-time Finite Volume Methods for Ice Sheet Modeling — Summer 2022
Summer Research Associate, Lawrence Berkeley National Laboratory
- Developed high-order finite volume methods for a simple model of solidification processes.
- Developed new algorithms for efficient geometry processing in embedded boundary simulations.
- Contributed to a high-performance C++/CUDA implementation of the above on NVIDIA GPUs

MIT Course Projects (Scientific ML, Stochastic Modeling and Inference) — Sept. 2020 – Dec. 2020
- Implemented an elastic rod model in Julia optimized for fast automatic computation of adjoints.
- Applied adjoint-based variational data assimilation algorithms to infer the trajectory of elastic structures from noisy data and a physics-based model.

An Immersed Interface Method for 2D Flows with Moving Boundaries — Aug. 2018 – May 2021
Graduate Research Assistant, MIT Van Rees Lab
- Developed finite-difference methods for 2D flows with moving bodies in vorticity formulation
- Implemented this method as a multithreaded 2D flow solver in C++.

SKILLS

Languages: C++, Python, Julia, MATLAB, Scheme
Applications: OpenFoam, ParaView, SolidWorks, Siemens NX
Certificates: “AI for Science on Supercomputers” from Argonne National Lab, 2022

AWARDS AND RECOGNITION

MIT SNAME Merit-Based Travel Grant	Feb. 2023
MIT MechE Research Exhibition: Best Lighting Talk	Oct. 2020
MathWorks Engineering Fellowship	Aug. 2019 – Aug. 2020
MAA Carl B. Allendoerfer Award (Mathematics Magazine)	July 2017
USC Presidential Scholarship and National Merit Scholarship	Aug. 2014 – May 2018

INDUSTRY EXPERIENCE

New Hampshire Ball Bearings Chatsworth, CA
Mechanical Engineering / Mathematics Intern Summer 2017

- Implemented numerical solvers and curve fitting to optimize cutting surfaces for CNC tooling.
- Created spreadsheets to estimate lubricant film thickness and forging loads for bearing retainers.

Beckman Coulter Brea, CA
Human Factors/Usability Engineering Intern Summer 2016

- Created and documented SolidWorks assemblies of over 600 unique parts for medical devices.
- Performed qualitative analysis of data from usability studies to determine sources of user error.

TEACHING EXPERIENCE

MIT 2.086: Numerical Computation for Mechanical Engineers Aug. 2020 – Dec. 2020
Teaching Assistant

- Worked closely with undergraduate students during weekly lab sessions and office hours.
- Wrote computational problem sets with an emphasis on real-world engineering applications.

PUBLICATIONS

J. Gabbard, W. M. van Rees. "A high-order finite difference method for moving immersed domain boundaries and material interfaces." *Journal of Computational Physics, 2024*

J. Gabbard, W. M. van Rees. "Lattice Green's Functions for High Order Finite Difference Stencils." *SIAM Journal on Numerical Analysis, 2024*

X. Ji, **J. Gabbard**, W. M. van Rees. "A sharp immersed method for 2D flow-body interactions using the vorticity-velocity Navier-Stokes equations." *Journal of Computational Physics, 2023*

J. Gabbard, W. M. van Rees. "A High Order 3D Immersed Interface Finite Difference Method for the Advection-Diffusion Equation." *AIAA SciTech Forum, 2023*

J. Gabbard, T. Gillis, P. Chatelain, W. M. van Rees. "An immersed interface method for the 2D vorticity-velocity Navier-Stokes equations with multiple bodies" *Journal of Computational Physics, 2022.*

J. Gabbard. "An immersed interface method for incompressible flow with moving boundaries and high order time integration." *Master's Thesis, Massachusetts Institute of Technology, Feb. 2020*

B. Conrey, **J. Gabbard**, K. Grant, A. Liu, K. Morrison. "Intransitive Dice." *Mathematics Magazine, Apr. 2016.*

PRESENTATIONS

J. Gabbard, W. M. van Rees. "A Performance Analysis of a High-Order 3D Immersed Interface Method Paired with a High-Order Wavelet-Based Adaptive Multiresolution Grid" *SIAM Parallel Processing, 2024*

J. Gabbard, Xinjie Ji, W.M. van Rees**.** "A high-order immersed interface method for elliptic PDEs with variable or discontinuous coefficients" *APS Division of Fluid Dynamics, Nov. 2023.*

J. Gabbard. "High order immersed interface methods for 3D simulations with moving boundaries." *Invited talk, MIT ACDL Seminar Series, March 2023.*

J. Gabbard, W. M. van Rees. "High-Order Method-of-Lines Time Integration for Sharp Immersed Methods with Moving Boundaries." *SIAM CSE, March 2023.*

J. Gabbard, W. M. van Rees. "A High-Order Immersed Interface Method for 3D Transport Equations." *APS Division of Fluid Dynamics, Nov. 2022.*

J. Gabbard, Thomas Gillis, W. M. van Rees. "A High-Order 3D Immersed Interface Method for Smooth Nonconvex Geometries." *North American High Order Methods Conference, July 2022.*

J. Gabbard, T. Gillis, W. M. van Rees. "Implementation and Scalability of a High-Order Immersed Interface Method on HPC Architectures." *SIAM Parallel Processing, Feb. 2022*

J. Gabbard, W. M. van Rees. "An immersed interface vortex method for internal and external 2D flows with moving boundaries." *APS Division of Fluid Dynamics, Nov. 2020.*