Justin Dong

– Providence, RI

✉ justin_dong@brown.edu   •   jdongg.github.io

Education

Brown University	**Providence, RI**
M.Sc., Applied Mathematics	*2019*
Ph.D. Candidate, Applied Mathematics	2023 (expected)

- Advisor: Mark Ainsworth

Rice University	**Houston, TX**
Bachelor of Arts, Computational and Applied Mathematics	*2014*
Bachelor of Science, Mechanical Engineering	

- Magna cum laude, distinction in research and creative work

Research Interests

- High-order accurate numerical methods for PDEs
- Computational fluid dynamics
- Machine learning for the solution of PDEs

Publications

- A. Howard, **J. Dong**, K. Yeo, P. Stinis, and M. Maxey. *Particle stress development in monodisperse suspension Poiseuille flows.* In preparation (2022).
- M. Ainsworth and **J. Dong**. *Galerkin Neural Network Approximation of Multiscale Problems.* Computer Methods in Applied Mathematics and Engineering. Computer Methods in Applied Mechanics and Engineering (2022).
- M. Ainsworth and **J. Dong**. *Galerkin Neural Networks: A Framework for Approximating Variational Equations with Error Control.* SIAM Journal on Scientific Computing **43**(4). A2474-A2501 (2021).
- **J. Dong** and B. Rivère. *A semi-implicit method for incompressible three-phase flow in porous media.* Computational Geosciences **20**(6). 1169-1184 (2016).
- J. Dong. *A high-order method for three-phase flow in homogeneous porous media.* SIAM SIURO Vol. 7, 2014.

Research & Work Experience

Brown University, Providence, RI	**September 2019 – Present**
Graduate Student Researcher	

Presently, I am working on deep neural network approaches to solving PDEs with my advisor, Professor Mark Ainsworth.

Pacific Northwest National Laboratory, Richland, WA	**May – July 2022**
Research Intern	

Developed a neural network approach using for learning closures of monodisperse and bidisperse suspension flows. Produced high-resolution approximations of several proposed suspension balance models using neural networks and analyzed the various models's efficacy in capturing particle scale dynamics. Advised by Dr. Amanda Howard.

Lawrence Livermore National Laboratory, Livermore, CA   May – July 2018
Research Intern
Implemented a two-dimensional solver for Maxwell's equation using a nodal discontinuous Galerkin method on GPUs. Integrated the solver with RAJA – a software abstraction layer for C++ enabling architecture portability for HPC applications – and mint – a mesh generation package. Advised by Dr. Arturo Vargas.

University of Stuttgart, Germany   March – August 2015
Visiting Research Scholar
Implemented a discontinuous Galerkin finite element method for two-phase flow in heterogeneous media with discontinuous capillary pressures, with particular attention given to interface conditions at the media boundaries. Research funded by Rice University's Wagoner fellowship. Advised by Professor Rainer Helmig.

Argonne National Laboratory, Lemont, IL   May – August 2014
Research Intern
Calibrated hydrological watershed models in parallel using a shuffled complex evolution (SCE) optimization. Implemented the code on Argonne's Blues computing cluster using the Swift parallel scripting language. Advised by Dr. Eugene Yan.

Rice University, Houston, TX   Jan 2013 – May 2014
Undergraduate Research Assistant
Developed a semi-implicit discontinuous Galerkin spatial discretization for three-phase flow in porous media and carried out simulations in highly heterogeneous media using data from the SPE10 dataset. This work was published in *Computational Geosciences* in 2016. Advised by Professor Béatrice Rivière.

ETH Zürich, Switzerland   May 2013 – July 2013
Research Intern
Carried out the implementation of an H(curl)-conforming discontinuous finite element method as well as implementation of an auxiliary subspace preconditioner for Maxwell's equations in MATLAB. Research funded by the ThinkSwiss fellowship.

Presentations

- Talk: *Galerkin Neural Network Approximation of Multiscale Problems*. SIAM Mathematics of Data Science, 2022.
- Talk: *Galerkin Neural Networks: A Framework for Approximating Variational Equations with Error Control*. SIAM Annual Meeting, 2021.
- Poster: *A High-Order Method for Incompressible Three-Phase Flow in Heterogeneous Porous Media*. SIAM Annual Meeting, 2014.

Honors & Awards

National Science Foundation Graduate Research Fellowship   March 2018

National Defense Science and Engineering Graduate Fellowship (declined)   April 2018

Teaching Experience

- CECS 0915 (Brown University Pre-College): Artificial Intelligence: Modeling Human Intelligence with Networks, instructor (Summer 2021). Developed all course materials, gave lectures, managed teaching assistants, and held office hours for a class of 30 students.
- Applied Mathematics 340: Methods of Applied Mathematics II, head teaching assistant (Spring 2019)
- Applied Mathematics 330: Methods of Applied Mathematics I, head teaching assistant (Fall 2018)

Mentoring Experience

- Simran Nayak (undergraduate): supervised an independent reading project in adaptive finite element methods for differential equations in one dimension (Fall 2018)
- Daniel Masotti (undergraduate): supervised an independent reading project in preconditioned Krylov subspace methods for large-scale linear systems of equations - ongoing (Spring 2019)
- Emily Reed (undergraduate): supervised an independent reading project in artificial neural networks (Fall 2019)
- Sam Chowning & Arturo Ortiz San Miguel: supervised an independent reading project on singular value decomposition and its applications (Fall 2020)

Computer skills

Languages: C/C++, MATLAB, Python

API: OpenMP, CUDA, MPI

Typesetting: LaTeX

Outreach & Service

Applied Math Directed Reading Program   **Aug 2018 – 2022**

Founder & Organizer

In Fall 2018, I founded the Department of Applied Mathematics's Directed Reading Program at Brown University, which allows advanced undergraduates to work one-on-one with graduate student mentors on independent reading projects. Some testimonials from undergraduates:

- "The mentorship I received was valuable both as an opportunity to hear first-hand mathematical expertise from a mentor as well as learn more about experiences from a female mentor in the math community."
- "[The DRP was] a great way to get interested undergraduates their first exposure to doing research and…begin to dive into a topic they can't just study in a more general class."

Faculty Graduate Liason   **Aug 2018 – 2021**

Division of Applied Mathematics, Brown University

I present budget requests from student organizations in the department to the department chair and convey concerns of graduate students to faculty.

Applied Math Graduate/Undergraduate Mentorship Program   **Jan 2018 – Present**
Organizer
The Graduate/Undergraduate Mentorship Program allows undergraduate applied math concentrators at Brown to receive one-on-one advising from graduate students. The program is geared towards undergraduates planning to go to graduate school or those who simply seek an extra avenue of advising beyond their faculty advisor.

Mathematics Resource Center   **Aug 2017 – May 2018**
Tutor

Rice University Undergraduate Admissions   **Dec 2014 – Present**
Alumni Interviewer