Abhijit Chowdhary
Department of Mathematics
North Carolina State University
Raleigh, NC

(240)-715-8308
achowdh2@ncsu.edu
https://abhijit-c.github.io/

Education

- **North Carolina State University** — Raleigh, NC
  Applied Math PhD (GPA: 4.0) — *Aug. 2020 - Present*
  - (Aug. 2021 - Present) — RA for Alen Alexanderian via NSF-DMS-2111044
  - (Aug. 2021) — Passed Qualification Exams (Matrix Theory, PDE, Analysis)
  - (Aug. 2020 - May 2021) — Recipient of the Siewert Fellowship
  - Coursework: Analysis I/II, PDE I/II, Matrix Theory I/II, Modeling I/II, Probability I, Uncertainty Quantification, Computational Inverse Problems, Advanced Functional Analysis, Numerical Nonlinear PDEs, Data-Driven Modeling and Analysis
- **New York University** — New York, NY
  B.A. Joint Mathematics and Computer Science, Classics Minor — *Sep.2016 - May.2020*
  - (In Major GPA: 3.657)
  - Relevant undergraduate courses: Algorithms, Chaos and Dynamical Systems, Computer System Organization, Operating Systems, Honors Algebra I/II, Honors Analysis I/II, Honors Linear Algebra, Honors Probability Theory, Numerical Computation, Topology.
  - Relevant graduate courses: Algebra, Basic Probability, Convex and Nonsmooth Optimization, Finite Element Method, Fundamental Algorithms, Geometric Modeling, High Performance Computing, Methods of Applied Math, Numerical Methods I/II, Partial Differential Equations.
- **University of Maryland** — College Park, MD
  Visiting Student (GPA: 3.925) — *Summer 2017,2018*
  - Coursework: Complex analysis, Number theory, Partial Differential Equations, Introduction to Artificial Intelligence.

Projects and Activities

- **HDSA enabling the Kullback Leibler Divergence as an UQ objective**
  (NCSU) Research with Alen Alexanderian — *Aug. 2021 - Present*
  - As a main objective as a research assistant for Dr. Alen Alexanderian, I worked on implementing theory from hyper-differential sensitvity analysis to enable taking efficient and exact derivaitves via adjoint-based gradient computation of the KL-Divergence in order to undertand its sensitivity in the context of uncertainty quantification.
  - In the process, using FENiCS (Python) I implemented a Bayesian linear inverse problem for a 3D linear elasticity model, stemming from the real-world problem of earthquake modeling, that served as a proof-of-concept of the theory. This model is planned to be reused in further work in Bayesian inverse problems as an interesting test problem.
  - Paper with the resulting work is currently in writing.
- **Well-Balanced Stochastic Galerkin for random PDEs**
  (NCSU) Numerical Nonlinear PDEs — *Apr. 2022 - May 2022*

- For a class final project, I along with Andrew Shedlock (NCSU) worked on an implementation of a well-balanced stochastic Galerkin method for PDEs with random forcing.
- Verified the results in the original paper, and did smaller studies on computational efficiency and noted places in the algorithm where one could take advantage of symmetry to improve runtime.
- Implemented first in MATLAB, and later rewritten in Julia to avoid unecessary allocations and take advantage of its pre-compilation step, achieving a 15x speedup.
- Link to the report.

- **HOGWILD!**
  (NYU) Convex and Nonsmooth Optimization *Apr. 2020 - May 2020*
  - For a class final project, I looked into a lock-free parallel stochastic gradient descent implementation, HOGWILD!.
  - Implemented the algorithm, and did a case study on the convergence and efficiency analysis. The goal was the to try and study the induced asynchronous noise as a function of bandedness in order to apply them to banded matrices arising from a discretization of a Poisson equation, but COVID-19 cut the project short.
  - Implementation with Eigen and OpenMP in C++.
  - Link to the report.

- **Math REU: Imperfect Periodic Patterns** Athens, OH
  Ohio University *June 2019 - August 2019*
  - I joined a research team under professor Qiliang Wu, and another undergraduate Mason Haberle from Berkeley in researching the field of pattern formation.
  - Our team specifically set out to prove nonlinear stability of the 2D Swift-Hohenberg equation at the zigzag boundary, and as of now we've completed the proof and the paper is in the draft stages.
  - The challenge here was mostly on how to adapt known techniques first to the Swift-Hohenberg equation, and second to higher dimensions. This was mostly a conceptual difficulty in the functional analysis framework surrounding the current research which we had to resolve.

- **Parareal**
  (NYU) High Performance Computing and Numerical Methods II *Apr. 2019 - May 2019*
  - For a class final project, I decided to look into parallel techniques for solving ordinary differential equations, in particular the parallel-in-time algorithm, *Parareal*.
  - For this project, I implemented and analyzed this algorithm, and further tested it's scaling properties on the HPC cluster Prince here at NYU.
  - Implemented with Eigen and OpenMP in C++
  - Link to the report.

- **Algebraic Point Set Surfaces Implementation**
  (NYU) Geometric Modeling *Apr. 2018 - May. 2018*
  - For a class final project, I implemented the theory in the paper *Algebraic Point Set Surfaces* by Gaēl Gunnebaud and Markus Gross from ETH Zurich.
  - The Paper presented an alternative method to take a point cloud to a triangularized mesh, and another method to estimate normals from a point cloud using algebraic fitting of a sphere.
  - This was mostly a challenge in comprehension of the paper and implementation, notably fighting with Eigen to try and constuct and solve the sytems in an efficient manner.
  - Implemented with Eigen, libigl, and nanoflann in C++

- **Tutor and TA at Courant** New York, NY
  NYU *Sep. 2017 - May 2019*

- Worked as a Tutor and TA to Professor Siegel at NYU for his undergraduate basic algorithms and graduate fundamental algorithms course.
- Hosted office hours, final exam study sessions, and worked on some of the course materials.

- **First Robotics Team Member, Team 2849: Ursa Major** Columbia, MD
  Hammond High School *Sep. 2012 - 2019*
  - A robotics team; every new year they gather for a challenge created by FIRST Robotics to build a robot in six weeks.
  - I worked as a build-team / programming-team flex member and team captain during my student years, and now I help as a programming and design mentor during their season.
  - Has managed to consistantly reach eliminantion and championship rounds at the regional level.
  - Link to their Github

Skills

Programming Languages: C, C++, Julia, Matlab, Python and a little Mathematica.

Libraries and Technologies: Num/Scipy, FEniCS, OpenMP, MPI, HPC Tooling (slurm, etc.), CUDA, Linux (have been using for over 8 years, currently on Fedora).

Languages: English, Latin, Broken spoken Hindi

Minor Mechanical Fabrication Skills