Nimaye Garodia

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EDUCATION

BSE Mech Eng (Honors), BS Math, BA Comp Sci, Aerospace Eng Minor — Aug 2022 – May 2026
Duke University — Durham, NC
GPA: 3.95/4.00

RESEARCH EXPERIENCE

Dynamics of Rotating Magnets | *Advisor: Dr. Thomas Witelski* — Aug 2025 – Present
Mechanical Engineering & Mathematics | *Differential Equations, Dynamical Systems* — Durham, NC
- Formulated equations of motion using Lagrangian mechanics for 3 nonlinear chaotic dynamical systems.
- Derived a mathematical model to estimate magnetic damping for interacting, relatively moving permanent magnets from Maxwell's equations.
- Obtained numerical solutions using Mathematica's PDE solver using the Runge-Kutta method.
- Designing and building a to-scale prototype using integrated axle ball bearings and permanent bar magnets to test numerical solutions.
- Analyzing chaos and stability using Lyapunov exponents, Lyapunov functions and power spectra.
- Wrote numerical Runge-Kutta (RK4) and numerical, iterative Q-R decomposition algorithms in C code to compute Lyapunov exponentials to characterize chaos.

Investigating the Action of Anesthesia | *PI: Dr. Ashutosh Kowal* — May 2024 – Present
Medical Physics | *Experimental Design & Fabrication, Numerical Algorithms, Data Analysis* — Durham, NC
- The primary purpose of the project is to determine the working principles of anesthetics, such as isoflurane and xenon, by mathematically analyzing *C. Elegans* posture and movement in response to exposure.
- Fabricated the experimental setup, including a backlight stand and "worm motel" enclosure, using 3D printing, computer-aided design and laser cutting.
- Innovated a darkfield illumination technique by applying first principles optics theory to obtain high-fidelity machine-vision videos, analyzable by a computer vision software Tierpsy.
- Obtained digitized time series data, effectively converting the analysis of *C. Elegans* into a signal processing problem.
- Developed various numerical algorithms in Python (to be used on large time-series datasets); numerical integration, wavelet transforms, density-based clustering, oscillation detection.
- Wrote an algorithm to compute Haar and Gaussian wavelet transform of the time series data.

Inverse Design of DNA Origami | *PI: Dr. Gaurav Arya* — Jan 2024 – Aug 2024
Mechanical Engineering & Material Science | *Scientific Programming, Deep Learning* — Durham, NC
- Studied the inverse design of DNA origami nanostructures using neural networks for structure prediction.
- Built algorithms to compute DNA configurations and match simulated crystal structures to initial conditions.
- Created boundary-condition and unwrapping algorithms for large LAMMPS simulations.
- Applied topological data analysis to extract lattice features from 10,000+ simulation results.

Aerodynamics of Bluff-Body Automobiles | *PI: Dr. Zbigniew Kabala* — Jan 2023 – Apr 2024
Aerospace Engineering | *ANSYS Fluent, CFD, Wind Tunnel Experimentation, Statistics* — Durham, NC
- Performed a comparative study using 3 representative geometries – Elantra, Corolla and Soul.
- Conducted 2D CFD simulations (RANS) using ANSYS Fluent to inform an initial, testable hypothesis.
- Built a setup to test CFD predictions for low Reynold's number flow in the Duke Wind Tunnel; manufactured my own custom jig to accurately record drag force magnitudes at low velocities.
- Ran wind tunnel experiments with to-scale 3D models of the cars.

PAPERS

Ava R. Martoma, N. Garodia, and Z. J. Kabala. "Drag on Cars: CFD Analysis of 2-D Body Design via ANSYS Fluent vs 3-D Wind-Tunnel Study with Toy Car Replicas." *Pioneer Academics*, 2024

N. Garodia and Z. J. Kabala. "On the Drag Prediction of Airfoils: 2 Methods to Potentially Improve Precision" *Pioneer Academics*, 2021

Projects

Electric Glider Improvement
Oct 2025 – Present

Senior Design Project; Client: Dr. Michimasa Fujino, HondaJet | *Aerodynamics, ANSYS CFD, XFOIL*   Durham, NC
- Reduced the Skynetic Andes glider sink rate by 5% and stall speed by 10% by adding a flaperon to the wing.
- Applied thin airfoil theory, XFOIL, ANSYS CFD and wrote proprietary code (in Matlab) to design the geometry.
- Ran experiments in the wind tunnel to confirm theoretical predictions with experimental results for C_D and C_L.
- Manufactured the flap using carbon fiber composites; integrated the flaperon into a complete control system with a PID and digital RC controller.

Avionics System for Model Rocket
Aug 2023 – Dec 2023

EGR190: Special Projects in Engineering | *Sensors, Electronics, Data Acquisition*   Durham, NC
- Engineered a flight computer to relay real-time telemetry data (velocity, altitude, pressure, etc.) to a companion ground station using radio waves.
- Measured stress on the fin during ascent using strain gauges, comparing it to established analytical models.
- Launched the rocket to 3000 ft.

Design & Construction of a Rural Footbridge
May 2023 – Jul 2023

Engineers in Action/DukeEngage | *Engineering Design*   Manzini, Eswatini (country in Southern Africa)
- Built Eswatini's longest footbridge across a treacherous river in 12 weeks, increasing school attendance by 200%.
- Managed design adaptation, materials, and site coordination with a 12-member team of fellow Duke students.
- Lived in spartan conditions in rural Eswatini, integrating with local Swazi culture.

XPRIZE Rainforest Drone
Jan 2023 – May 2023

ECE365: Rainforest Engineering | *Dynamics, Controls*   Durham, NC
- Participated in the $10M XPRIZE Rainforest competition, developing autonomous biodiversity monitoring technologies to rapidly assess rainforest ecosystems and support conservation efforts.
- Contributed to a drone capable of deployment & recovery of bioacoustic sensors in rainforest research.
- Derived and tuned a controller for steady-state level-flight in 6 degrees of freedom using PID techniques, achieving stable, level flight; tested through flight in the Duke Forest.

Teaching and Mentorship

Teaching Assistant, Duke University
Jan 2023 – May 2024

- Helproom TA, Advanced Intro to Multivariable Calculus: Math 222   Fall 2023, Spring 2024
  * Weekly tutoring for students taking advanced introductory multivariable calculus class.
  * Ensured a rigorous understanding of calculus in $\mathbb{R}^n$.
  * developed my own proofs for theorems unproved in class, for the students' benefit.
- Helproom TA, Calculus I & II: Math 105, 106, 111, 112   Spring 2023
  * Provided biweekly assistance to students struggling with calculus courses.
  * Explained topics from first principles, emphasizing intuition building.

Honors and Awards

Dean's List with Distinction: Given to top 10% of all engineering undergraduates.   Fall 2022, Fall 2023, Spring 2025
Pi Tau Sigma: Mechanical engineering honor society. Inducted in early admission.   Mar 2025
Tau Beta Pi: Nation's biggest engineering honor society. Inducted in early admission.   Oct 2024
Dean's List: Given to top 1/3rd of all engineering undergraduates.   Spring 2023, Spring 2024
Guinness World Record: Set a record for most number of airlines recognized by tails in 1 minute.   Oct 2021

Skills

Programming: Python (SciPy, SymPy, NumPy, Pandas), C/C++, Java, R, JavaScript, HTML/CSS, Shell Scripting, LaTeX
Operating Systems: Linux (Ubuntu & Debian), Windows, macOS
Engineering Prototyping Tools: SolidWorks, Fusion 360, AutoCAD, Arduino, FPGA (Verilog/HDL)
Modeling Methods: Finite Element Analysis, Computational Fluid Dynamics, PID Control
Computational Methods: Python, Matlab, Wolfram Mathematica, ANSYS Fluent, Maple
Fabrication: Machining (Shop Certified), 3D Printing, Laser Cutting, Metalwork
Languages: English (Native), Hindi (Native), Spanish (Proficient), French (Elementary)