



Arnaldo Rodriguez-Gonzalez

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👤 Profile

Born 8 December 1992

EDUCATION

2016 – 2022

Ph.D., Theoretical & Applied Mechanics

Cornell University, Sibley School of Mechanical & Aerospace Engineering

- Advisor: Brian J. Kirby

2010 – 2015

B.S., Mechanical Engineering

University of Puerto Rico—Mayagüez, Department of Mechanical Engineering

- Minor in Applied Mathematics
- Graduated Magna Cum Laude

TEACHING EXPERIENCE

Nov. 2022 – Nov. 2023

Active Learning Initiative Postdoctoral Fellow, Cornell University

- Designed and implemented an active learning activity for Cornell's engineering statics course, where students learn about the stability of load-bearing vehicles through a guided exploration involving custom-built scale models of forklifts for the Toyota Forklift Learning Studio. See here for the activity hand-out/structure.
- Designed and implemented an active learning activity for Cornell's thermodynamics course, where students learn about the concept of defining thermodynamic systems via interaction with real-world functioning heat exchangers and torque brakes.
- Designed an active learning activity for Cornell's system dynamics course, where students learn about the concept of first-order systems via interaction with torque brakes.
- Wrote a textbook on qualitative dynamics and chaos.

June 2022 – August 2022

Graduate Lecturer, Cornell University

Dynamics, Mechanical and Aerospace Engineering Department

- Sole instructor for the introductory dynamics course; learning strategies included oral/written exams, mastery assessments/regarding, and final project designing spaceship trajectories.
- See here for an (incomplete) list of teaching evaluations for this course.

January 2021 – May 2021

Graduate Teaching Assistant, Cornell University

Dynamics, Prof. Andy Ruina, Mechanical and Aerospace Engineering Department

- Designed and taught an introductory MATLAB workshop for ~100 students.
- Designed multiple interactive modules in MATLAB about common dynamical systems for students to use. See here.
- Constructed and taught weekly discussion sections about dynamics problems to 20 students.
- Assisted students with homework and exam practice during office hours and review sessions, in person & online.
- Created multiple animations of sophomore-level dynamical phenomena discussed in class. See here.
- Graded and proctored exams.
- Administered homework delivery and submission, as well as providing student feedback on Canvas and Ed Discussion.
- Received an H.D. Block Prize in 2021 for teaching excellence as a result of my work.

January 2018 – May 2018,
August 2019 – December 2019,
August 2020 – December 2020

Graduate Teaching Assistant, Cornell University

Fluid Mechanics, Prof. Brian Kirby, Mechanical and Aerospace Engineering Department

- Designed and delivered a guest lecture on buoyancy and pressure-induced forces in fluids.
- Developed a proto-textbook on introductory fluid mechanics for student use. See [here](#).
- Created homework and solutions for the course on mathematical methods of fluid mechanics. Sample [here](#).
- Assisted students with homework and exam practice during office hours and review sessions, in person & online.
- Created multiple animations of fluid mechanical phenomena discussed in class. See [here](#).
- Assisted instructor with the development of an index on vector and tensor calculus for future editions of their textbook.
- Graded and proctored exams.
- Administered homework delivery and submission, as well as providing student feedback on Canvas and Ed Discussion.
- Received an H.D. Block Prize in 2019 for teaching excellence as a result of my work.

May 2020 – May 2021

ELI TA Development Consultant, Cornell University

Teaching Assistant Development Program, Dr. Celia Evans

- Co-created and implemented a course on using active learning techniques in the classroom for hundreds of novice teaching assistants as part of the College of Engineering's Engineering Learning Initiatives (ELI) program.

RESEARCH EXPERIENCE

Nov. 2022 – Nov. 2023

Postdoctoral Fellow, Cornell University

- Wrote and submitted for review a preprint ([see here](#)) on the adaptation of symbolic dynamical methods to analyze chaos and mixing on dynamical systems defined over continua. Its contents were well-received at the SIAM DS 2023 conference.
- Collaborated with William Clark among others on a preprint describing the use of neural delay differential equations to "learn" delay parameters in standard delay differential equation models.

August 2016 – November 2022

Graduate Student Researcher, Cornell University

- Extended and improved a framework by which the co-existence of chaotic properties can be shown or not shown in systems that behave like an extension of symbolic dynamical systems (symbolic systems which may not be shift-invariant).
- Engaged in work on the generation of picoliter chemical reactors, made with a specialized microfluidic device designed to induce chaotic mixing, for high-throughput analysis on the boundaries between chaotic and periodic behavior in the B-Z reaction. Collaboration with Prof. Perrine Pepiot.
- Demonstrated the existence of multiple solutions to a nonlinear boundary-layer problem, previously believed to only have one solution, using perturbation theory. Part of a collaborative effort led by Prof. Steven Strogatz, this work is currently under review to be published in the SIAM Review.
- Using a formalism based on symbolic dynamics, developed a rational design protocol for high-throughput microfluidic devices that sort colloidal particles in suspensions by size. A paper on this work was published in *Physical Review E*. Collaboration with Prof. Jason Gleghorn.
- Collaborated on a study of the rheology of gold nanorod suspensions with Prof. Emmanuel Giannelis and Prof. Gregory Fuchs. A paper on this work was published in *Small*.

August 2015 – May 2016

SULI Intern, Lawrence Berkeley National Laboratory

- Work involved identifying characteristic acoustic emissions from superconducting magnet quenches and associating frequency signatures with accelerator locations.
- Phononic crystal models of magnet cabling were also developed.
- These results were presented at the first annual US Magnet Development Program meeting in early 2017.

January 2015 – August 2015

Research Assistant, HP Analytical Chemistry Lab

- Dual-phase hydrodynamics models were developed to investigate the effect of boehmite nanocrystals on sedimentation in non-Newtonian ink dispersions.
- This work began as part of a senior capstone project on soft matter dynamics.

May 2014 – August 2014

Undergraduate Research Assistant, Laboratorio Nazionale del Gran Sasso / Columbia University

- Developed computational fluid dynamics models to simulate dual-phase xenon recovery flow for the XENON1T Dark Matter Experiment.
- Helped with XENON1T component installation procedures & verification tests.
- Assisted XENON100 operations group with detector maintenance and radiation calibration tests.

May 2013 – August 2013

Undergraduate Research Assistant, California Institute of Technology / LIGO Collaboration

- Generated a series of coupled-field thermorefractive and thermoelastic models to simulate & control transient thermal effects in Advanced LIGO test masses.
- Characterized electromagnetic mode losses in Advanced LIGO's optical cavities due to refractive aberrations.
- These results were used in a poster by the Auxiliary Optics group at the 2013 LSC-Virgo collaboration meeting in Hanover.

May 2012 – August 2012

SIST Intern, Fermi National Accelerator Laboratory

- Developed coupled-field finite-element models to simulate the dynamics of runaway quenching phenomena in superconducting accelerator magnets.
- Performed creeping stress studies on high-temperature superconducting magnets during fabrication.
- This work resulted in a cited technical report, and was used in a presentation for the Muon Accelerator Program at the 2012 Fermilab HTS Workshop.

PUBLICATIONS/TECHNICAL REPORTS

1. **Rodriguez-Gonzalez, A.** "Analyzing Topological Mixing and Chaos on Continua with Symbolic Dynamics". *arXiv preprint*, 2023.
2. Oprea, M., Walth, M., Stephany, R., Nothaft, G. T., **Rodriguez-Gonzalez, A.**, Clark, W. A. "Learning the Delay Using Neural Delay Differential Equations". *arXiv preprint*, 2023.
3. Clark, W. A., Gomes, M. W., **Rodriguez-Gonzalez, A.**, Stein, L. C., Strogatz, S. H. "Surprises in a Classic Boundary-Layer Problem". *SIAM Review*, 2023.
4. **Rodriguez-Gonzalez, A.**, Gleghorn, J. P., Kirby, B. J. "Rational Design Protocols for Size-Based Particle Sorting Microdevices Using Symmetry-Induced Cyclical Dynamics". *Physical Review E*, 2020.
5. Liu, X., Qi, G., Park, A. M. G., **Rodriguez-Gonzalez, A.**, Enotiadis, A., Pan, W. Y., Kosma, V., Fuchs, G. D., Kirby, B. J., Giannelis, E. P., "Scalable Synthesis of Switchable Assemblies of Gold Nanorod Lyotropic Liquid Crystal Nanocomposites". *Small*, 2019.
6. **Rodriguez-Gonzalez, A.**, Shen, T. "Determining Stability Margins in Superconducting Magnets using 3-D Finite Element Analysis". *Fermilab Technical Report*, 2012.

TEACHING RESOURCES

- Textbook on Qualitative Dynamics and Chaos
- Forklift Active Learning Activity
- Proto-Textbook on Introductory Fluid Mechanics
- Introductory Fluid Mechanics Homework/Solution Sample
- List of Interactive Learning Modules for Students
- Summer 2022 Lecturer Reviews
- Mid-Semester 2019 Teaching Assistant Reviews
- Mid-Semester 2021 Teaching Assistant Reviews
- YouTube Playlist on Fluid Mechanics
- YouTube Playlist on Dynamical Systems

AWARDS/FELLOWSHIPS

- H. D. Block Graduate Teaching Prize, awarded in both 2021 & 2019.
- Cornell Sloan Fellowship, 2016-2020.

TALKS/PRESENTATIONS

Invited Talks

1. A Trajectory in Dynamical Systems, *Ithaca College Dynamics REU Talk*, July 2023.
2. Understanding Colloidal Particle Dynamics in Microfluidic Obstacle Lattices with Symbolic Dynamics, *NORDITA Soft Matter Seminar*, September 2020.

Conference Presentations

1. Analyzing Mixing and Chaos on Continua with Symbolic Dynamics, *SIAM Conference on Applications of Dynamical Systems*, May 2023.
2. A Microfluidic Platform for Analyzing Chemical Reaction Dynamics, *SIAM Conference on Applications of Dynamical Systems*, May 2021.
3. Electrokinetic Manipulation of Coherent Structures in the Belousov-Zhabotinsky Reaction: Theory and Methods, *13th International Symposium on Electrokinetics (ELKIN)*, 2019.

Departmental/Local Talks

1. The Pathology of Chaotic Continua & Applications to Chaotic Mixing, *Cornell Applied Dynamics Seminar*, February 2022.
2. Modernist Motion: Symbolic Dynamics as a Tool for 21st Century Science, *Cornell Applied Dynamics Seminar*, May 2020.
3. Invariance as Information: Exploiting Symmetries in Mathematical Models, *SIGMA Seminar*, November 2018.
4. Manipulating Colloidal Particle Dynamics in Microfluidic Channels with Particle-Obstacle Interactions, *Cornell Fluids Seminar*, February 2018.
5. Open Problems in Theoretical Mechanics: A Bird's Eye View, *SIGMA Seminar*, October 2017.
6. Microscale Fluid Mechanics: Concepts and Innovations, *Summer STEM Colloquium*, August 2017.

CONFERENCE ACTIVITY

- SIAM Conference on Applications of Dynamical Systems, oral presenter, 2023.
- SIAM Conference on Applications of Dynamical Systems, oral presenter (virtual), 2021.
- 13th International Symposium on Electrokinetics, poster presenter, 2019.
- IUTAM Symposium on Stochastic Dynamical Systems Approaches to Fluid Flow Transitions, attended, 2018.

OUTREACH EXPERIENCE

- Gave an invited talk to REU students at Ithaca College on academic careers and on research guidance in the field of dynamical systems.
- Regularly created well-received "micro-lessons" on dynamical systems for the general public on my Twitter account, @Arnaldo_AGITF.
- Created the highly-received and fully-enrolled "Theoretical Physics 101: How To Learn About The Universe or Die Trying" course for a high-school audience as part of the Splash! Cornell program, taught three times from November 2017 to November 2018.
- Also created the successful "Math for People Who Hate Math" course for the Splash! Cornell program for a high-school audience, taught in April 2019.
- Created a two-day course module on boats for the 4-H Career Explorations Event in 2018 on "Rockets, Boats & Bridges" that is still in use.

PROFESSIONAL TRAINING

- Have experience assembling equipment and tools for use in laboratory activities “from scratch”, as well as implementing them effectively in the classroom.
- Trained to work in an ISO M6 cleanroom by Cornell Nanoscale Facility staff, as well as in most equipment used for “soft photolithography” in 2019.
 - ABM High Resolution Mask Aligner
 - Heidelberg DWL 2000 Photomask Writer
 - Harris Basic Plasma Cleaner
- Trained in optical microscopy and microplate photometry in 2018.
- Trained as a graduate teaching assistant by Cornell’s Engineering Learning Initiatives program in 2018.

EXTRACURRICULAR UNIVERSITY SERVICE

- Ran Cornell’s Applied Dynamics Seminar in the fall 2023 semester, and co-coordinated the SIAM student chapter’s yearly open house.
- Served as the Theoretical & Applied Mechanics field representative in Cornell’s Graduate and Professional Student Assembly from 2016 to 2018.
- Served as an active member of the Sibley Graduates in Mechanical & Aerospace Engineering (SiGMA) association from 2016 to 2018.
- Worked as a teacher for the Splash! Cornell program from 2017 to 2019.

COMPUTATIONAL SKILLS

Programming Languages

1. MATLAB, full professional proficiency.
2. Mathematica/Wolfram, full professional proficiency.
3. Python, professional working proficiency.
4. Julia, professional working proficiency.
5. FORTRAN, limited working proficiency.
6. C++, limited working proficiency.









Other Software

1. COMSOL, full professional proficiency.
2. MS Office, full professional proficiency.
3. ANSYS, professional working proficiency.
4. SolidWorks, professional working proficiency.
5. KLayout, professional working proficiency.

LANGUAGES

- English, fluent.
- Spanish, fluent.
- Italian, professional working proficiency.
- French, limited working proficiency.
- Russian, elementary proficiency.
- Turkish, elementary proficiency.

REFERENCES

- Brian J. Kirby, Meinig Family Professor of Engineering, Cornell University.
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 -  Profile
- Steven H. Strogatz, Jacob Gould Schurman Professor of Applied Mathematics, Cornell University.
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- William Clark, Assistant Professor, Ohio University.
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