Gary K. Nave, Jr.

Postdoctoral Associate

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Current Position

2018-Pres **Postdoctoral Associate**, *Biofrontiers Institute*, University of Colorado Boulder.
Supervisor: Orit Peleg
Research focus: My current work involves studying the collective behavior of insects, both in honey bees and fire ants. The work involves both experimental research with honey bees and agent-based modeling methods to investigate the underlying decisions that lead to observed behaviors.

Education

July 2018 **Ph.D. Engineering Mechanics**, *Virginia Tech*, Blacksburg, VA.
Dissertation: Nonlinear models and geometric structure of fluid forcing on moving bodies
Advisors: Shane Ross and Mark Stremler
Committee: Jake Socha, Nicole Abaid, and Craig Woolsey
Research focus: In my graduate work, I focused on flow induced vibration of tandem cylinders and the dynamics of passive descent, including glidering animals. I also developed methods to detect regions of attraction and repulsion in dynamical systems and fluid flows. I conducted this research through an NSF-funded interdisciplinary research program focused on biological transport, which has exposed me to problems in biology and collaboration with biologists working in similar areas.

Preparing the Future Professoriate Graduate Certificate.
This program, developed by Dean Karen DePauw of Virginia Tech, is designed to prepare graduate students for a faculty career. Features coursework on contemporary pedagogical practices and issues in higher education. Additionally, I visited 10 universities in Europe and Ecuador to gain a global perspective in higher education.

2012 **B.S. Engineering Science and Mechanics**, *Virginia Tech*, Blacksburg, VA.
Senior Design: Dispersed sensing through chaotic motion
Minor: Mathematics

Publications and Presentations

Journal Articles

Nave Jr., Gary K., Nelson T. Mitchell, Jordan A. Chan Dick, Tyler Schuessler, Joaquin A Lagarrigue, and Orit Peleg (2020). "Attraction, Dynamics, and Phase Transitions in Fire Ant Tower-Building". In: *Frontiers in Robotics and AI* 7, p. 25.

Nave Jr., Gary K, Peter J Nolan, and Shane D Ross (2019). "Trajectory-free approximation of phase space structures using the trajectory divergence rate". In: *Nonlinear Dynamics* 96.1, pp. 685–702.

Nave Jr., Gary K. and Shane D. Ross (2019). "Global phase space structures in a model of passive descent". In: *Communications in Nonlinear Science and Numerical Simulation* 77, pp. 54 –80.

Chang, Brian, **Gary K. Nave Jr.**, and Sunghwan Jung (2012). "Drop formation from a wettable nozzle". In: *Communications in Nonlinear Science and Numerical Simulation* 17.5, pp. 2045–2051.

Nave Jr., Gary K., Brock Davis, Katrina Somers, Hope Gruszewski, Shane D. Ross, and David G. Schmale III. "3D-printed maple seeds for atmospheric sensing". In preparation.

Nave Jr., Gary K. and Mark A. Stremler. "Wake stiffness as a nonlinear spring". In preparation.

Peer-reviewed Conference Proceedings

Nave Jr., Gary K., Amy L. Hermundstad, Chelsea Corkins, Emily Garner, Jeena R. Jayamon, Mohammed Seyam, Michael Stewart, Michele Waters, and Karen P. DePauw (June 2017). "Global perspectives: graduate students' experiences with global higher education". In: The American Society of Engineering Education annual conference. Columbus, Ohio.

Nave Jr., Gary K., Mark Stremler, and Shane D. Ross (Aug. 2016). "Wake stiffness and its application: oscillating cylinders and flying snakes". In: *Proceedings of the 24th International Congress on Theoretical and Applied Mechanics (ICTAM)*. Montreal, Canada.

Invited Talks

Apr 2019 **Applied Math Seminar**, *University of Pittsburgh*.

Oct 2018 **Complex/Dynamical Systems Seminar**, *University of Colorado Boulder*.

Sept 2017 **Math Biology Seminar**, *Virginia Tech*.

Conference Presentations

Nave, Jr., Gary K. and Mark A. Stremler (Aug. 2020). *Modeling Wake Stiffness as a Nonlinear Spring*. Glasgow, Scotland: Accepted for presentation at the International Conference on Engineering Vibration. MAS is the presenting author.

Nave Jr., Gary K., Hadley Tallackson, and Orit Peleg (Jan. 2020a). *Modeling decision-making in fire ant tower and honey bee swarm formation*. Denver, Colorado: Presented at the Joint Math Meetings 2020.

– (Jan. 2020b). *The Formation of Honey Bee Swarms*. Austin, Texas: Presented at the Society for Integrative and Comparitive Biology Annual Meeting.

Nave Jr., Gary K. and Orit Peleg (June 2019). *Coming together to climb higher: agent-based modeling of fire ant tower building*. Atlanta, Georgia: Presented at the American Chemical Society Colloids and Surface Science meeting.

– (Dec. 2018). *The surface tension of honey bee swarms*. Philadelphia, Pennsylvania: Presented at the Social Insects in the Northeast Regions meeting.

Nave Jr., Gary K. and Shane D. Ross (Jan. 2018). *Slow manifolds in the aerodynamic descent of animals and plants*. Denver, Colorado: Poster and short talk presented at Dynamics Days 2018.

Nave Jr., Gary K. (Nov. 2017). *Understanding gliding flight with the terminal velocity manifold*. Blacksburg, Virginia: Presented at the southeast regional Society of Integrative and Comparative Biology meeting.

Nave Jr., Gary K. and Shane D. Ross (May 2017). *Phase space structures in velocity space for gliding and falling bodies*. Mini-symposium: Recent advances in character-

ization of nonautonomous dynamical transport. Snowbird, Utah: Presented at the Society of Industrial and Applied Mathematics Dynamical Systems Meeting.

Yeaton, Isaac J., Grant A. Baumgardner, Talia M. Weiss, **Gary K. Nave Jr.**, Shane D. Ross, and John J. Socha (2016). *Snakes in a Cube: high-resolution kinematics of gliding in flying snakes*. Presented at the Society for Integrative and Comparative Biology. Portland, OR.

Nave Jr., Gary K. and Mark Stremler (2015). *Regimes of flow induced vibration for tandem, tethered cylinders*. Presented at the 68th Annual American Physical Society Division of Fluid Dynamics Meeting. Boston, MA.

Yeaton, Isaac J., Grant A. Baumgardner, Talia M. Weiss, **Gary K. Nave Jr.**, Shane D. Ross, and John J. Socha (2015). *What's its wave? A 3D analysis of flying snake locomotion*. Presented at the 68th Annual American Physical Society Division of Fluid Dynamics Meeting. Boston, MA.

Nave Jr., Gary K., Tyler Michael, Pavlos Vlachos, and Mark Stremler (2014). *Flow-induced oscillations of tandem tethered cylinders in a channel flow*. Presented at the 67th Annual American Physical Society Division of Fluid Dynamics Meeting. San Francisco, CA.

Teaching Experience

Guest Lectures

Dynamical Models in Biology, CSCI 4314/5314, University of Colorado Boulder

A combined undergraduate/graduate course in the Computer Science department.

(Spring 2020) I developed and taught 6 lectures through the course of the current semester and helped plan the course topics. I taught topics including Markov chains in cancer modeling, animal locomotion, cellular automata, and pattern formation, and collective behavior.

(Spring 2019) I taught one couse, providing an introduction to modeling with differential equations and their behavior in phase space, using the example of the gliding behavior of flying snakes.

Advanced Dynamics, ESM 6314, Virginia Tech

PhD-level survey of advanced research in dynamical systems.

Taught a two-lecture series providing an introduction to the theory of smooth manifolds, including the tangent bundle, Lie groups and Lie algebras, and their relevance to the study of dynamics.

Dynamics, ESM 2304, Virginia Tech

Sophomore-level introductory engineering course.

I taught two substitute lectures for a sophomore-level dynamics course. The first lecture was an introduction to the impulse-momentum equations and the dynamics of collisions. The second lecture was an introduction to rigid body rotation about a fixed axis and the parallel axis theorem.

Foundations of Engineering II, ENGE 1216, Virginia Tech
Freshman-level foundations of engineering course.
I gave guest lectures on two occasions, discussing the Engineering Science and Mechanics major at Virginia Tech and highlighted my own research and potential opportunities in engineering.

Workshops

Introduction to Agent-Based Modeling with Python
Developed a workshop to provide a basic introduction to agent-based modeling in Python for the Quantitative Exploration and Discussion Supergroup. Offered in Spring 2020. Available at `github.com/gknave/Python_Intro`.

Intermediate Python
Developed a workshop to introduce fellow postdocs to practical tools for scientific research using Python. Materials available at `github.com/gknave/Python_Intro`.

Introduction to Python
Developed a workshop to provide a basic introduction to programming in Python for fellow postdocs. Offered in both Spring 2019 and Fall 2019. Available at `github.com/gknave/Python_Intro`.

LaTeX Workshop
Developed a workshop to provide fellow graduate students with an introduction to LaTeX, a document preparation software.

Mentorship and Advising

2019 **CU Science Discovery program**
Mentored a team of 3 high school students to experimentally study the movement of individual honey bees under different temperature conditions. Helped the students conduct, analyze, and visualize experiments.

2019 **CU Summer Program for Undergraduate Research**
Advised a senior undergraduate in the Peleg Lab. Developed and supervised agent-based modeling research and an experimental study of honey bee behavior.

2012-2018 **Graduate Mentor**
As a graduate student in both the Ross Dynamics Lab and Stremler Fluids Lab, I advised numerous undergraduate and younger graduate students in their research, both formally and informally.

2014-2015 **Engineering Science and Mechanics Senior Design**
Advised a senior design team which built upon my own research to develop energy harvesters from flow-induced vibration. Held regular meetings with the team, advised them on experimental methods, and provided broader context to their research project.

Awards & Recognition

2018 Dynamics Days 2018 Student Travel Award

2017 **Virginia Tech Outstanding Graduate Student Leader**.
Nominated by the faculty of my department and peers and was selected to win this award through the Virginia Tech University Student Leader Awards. Granted on the basis of my leadership through organization and service to the University community.

2017 SIAM Student Travel Award

2014 NSF IGERT traineeship, MultiSTEPS

2014 Virginia Tech College of Engineering Outstanding M.S. Student

2014 Manuel Stein Scholarship

2010 Ken and Loretta Reifsneider Scholarship

Professional Development

Aug. 2019 **Evidence-Based Introduction to Teaching**, *Boulder, CO.*

This week-long workshop was offered by the Center for the Integration of Research, Teaching, and Learning. In the course, participants learned about active teaching techniques, discussed discipline-based education research, and put new ideas into practice by developing a microteaching module.

Mar. 2018 **Critical Transitions in Complex Systems Winter School: Mathematical theory and applications**, *Wöltingerode, Germany.*

This event is part of the activities of the "Critical Transitions in Complex Systems" Marie Curie Initial Traning Network bringing together scientists in mathematics and applications on progressing the understanding of critical transitions in complex systems ranging from ecology and climate to economic theory.Discussions covered slow-fast systems, stochastic differential equations, and equation-free detection of attracting manifolds.

June 2017 **SHIFT 21st Century Faculty Institute**, *Blacksburg, VA.*

elped organize and participated in a week-long faculty development program at Virginia Tech with visiting faculty members from Universidad San Francisco de Quito.

Nov. 2016 **Global Perspectives Program**, *Ecuador.*

The global perspectives program is a selective program run by Dean DePauw of the graduate school at Virginia Tech. Through this program, I was selected as one of five Virginia Tech graduate students to visit Universidad San Francisco de Quito and Escuela Politecnica Nacional to help form partnerships with these universities.

June 2016 **Global Perspectives Program**, *Switzerland, France, and Italy.*

The global perspectives program is a selective program run by Dean DePauw of the graduate school at Virginia Tech. The program consists of two weeks of visiting higher education institutions primarily in Switzerland. Our group visited a total of 8 universities of varying size and emphasis and had a number of conversations with students, staff, and faculty about the future of higher education in Europe and around the world.

2014 **VTKnowledgeWorks Tech Transfer Challenge**, Finalist.

Led a team pitching "Hydrokinetic Energy Systems" that was a finalist in the Tech Transfer Challenge, an entrepeurial pitch competition for technology transfer from the research lab to the market.

2014 **ACC Clean Energy Challenge**, *University of Maryland*, Semi-finalist.

Led a team selected as a semi-finalist in the ACC Clean Energy Challenge, a competition for schools across the Southeast United States. Our project was entitled "enVIV: Energy from Vortex Induced Vibration"

2013 **Ambassador Leadership Forum**, *Eastman Chemical Company.*

Facilitated a collaborative partnership between the Virginia Tech College of Engineering and Eastman Chemical Company. As a result of this collaboration, Eastman invited myself and a group of student ambassadors under my supervision to participate in this leadership development forum.

Work Experience

2016-2018 **Graduate Research Assistant**, *BioTrans Program*, Virginia Tech.
Virginia Tech Graduate School funded interdisiciplinary research assistantship. Under this funding, I have worked to understand the underlying mechanics of falling and gliding objects, such as animal gliders.

2014-2016 **Graduate Research Assistant**, *MultiSTEPS Program*, Virginia Tech.
NSF-funded interdisciplinary research assistantship focused on material transport at the boundary between biologists and engineers. In the first year of the program, I conducted research projects with 3 different advisors in different fields to develop as an interdisciplinary researcher and took courses in engineering, and biology as well as interdisciplinary grant writing.

2012-2014 **Director of Undergraduate Recruiting**, *College of Engineering*, Virginia Tech.
Coordinated all recruiting activities for the College of Engineering. Led the Dean's Team, a group of 38 undergraduate students who aid in recruiting activities. Planned and coordinated annual Engineering Open House for over 1,000 visitors each year. Presented daily to prospective undergraduate students.

Service

2019-Pres **Advisory Board Member**, Postdoctoral Association of Colorado (PAC) Boulder

2016-2018 **Founder and President**, Graduate Engineering Mechanics Society

2017 **Director of Programs**, Graduate Student Assembly (GSA)

2016-2017 **Mentor**, Virginia Tech Early Engineering Mentoring Program

2016 **Funding Programs Chair**, Graduate Student Assembly (GSA)

2015-2017 **Mentor**, Graduate Undergraduate Mentoring Program

2014-2017 **Delegate**, Graduate Student Assembly

2015-2016 **Member**, GSA Committee on Graduate Inclusion and Diversity Policies

2015 **Member**, Virginia Tech Graduate Student of the Year Selection Committee

2014-2015 **Advisor**, Undergraduate Senior Design team

2012-2016 **Mentor**, Student Transition to Engineering Program