Profile of Sridevi "Sri" Sarma

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- *IEEE Control Systems Society experience highlights*: associate editor, *IEEE Transactions on Biomedical Engineering.*
- *Notable awards*: L'Oréal USA For Women in Science fellowship; Burroughs Wellcome Fund Careers at the Scientific Interface Award; Krishna Kumar New Investigator Award from the North American Neuromodulation Society; Presidential Early Career Award for Scientists and Engineers; Whiting School of Engineering Robert B. Pond Excellence in Teaching Award.

of gamblers who change their bets despite the odds of winning remaining the same. This variability is at least partially explained by internal factors, including emotions or preferences, both of which may be difficult to measure but may be tractable to model. Take a gambler's emotions, which are likely modulated by past outcomes. One can thus model how a gambler's emotions fluctuate by creating a latent state variable that follows an update law based on past outcomes and then allow this latent variable to influence betting behavior in addition to stimuli. The latent state variable can then be correlated to neural activity. We published a recent study wherein we demonstrate how a simple state-space model can predict highly variable betting behavior and how the state variable is encoded in the brain via a right–left push–pull neural system (https://www.pnas.org/content/116/4/1404).

Q. You have edited one book in the control field. What topics does this book cover?

***Sri*:** I edited one book (with Zhe Chen), *Dynamic Neuroscience*, which covers topics of neural signal processing, statistical modeling of neural data, and control applications in neuroscience.

Q. What are some of your interests and activities outside of your career?

***Sri*:** I enjoy playing tennis and the violin.

Q. Thank you for your comments.

***Sri*:** Thank you for reaching out to someone who trained in systems and control theory and then took a deep dive into neuroscience.

DEREK A. PALEY

Q. How did your education and early career lead to your initial and continuing interest in the control field?

***Derek*:** Excellent instructors in physics at the high school and college freshman levels led me to major in applied physics as an undergraduate. The applied physics major included two semesters of independent research, during which I studied the physics of medical imaging. I worked for five years after college (first as an analyst at a scientific consulting firm and then as a software engineer at a robotics company) before going to graduate school. It was at my first job after college (which was featured in the book *100 Great Jobs and How to Get Them*) where I learned about autonomous underwater vehicles that could scour the ocean for scientific data and communicate with one another acoustically to travel like a school of fish. This technology captured my imagination and led to my second job (postponing graduate school for another two years), where I implemented real-time feedback controls and autonomous behaviors for small unmanned submarines.

Derek A. Paley

Digital Object Identifier 10.1109/MCS.2019.2961732
Date of current version: 17 March 2020

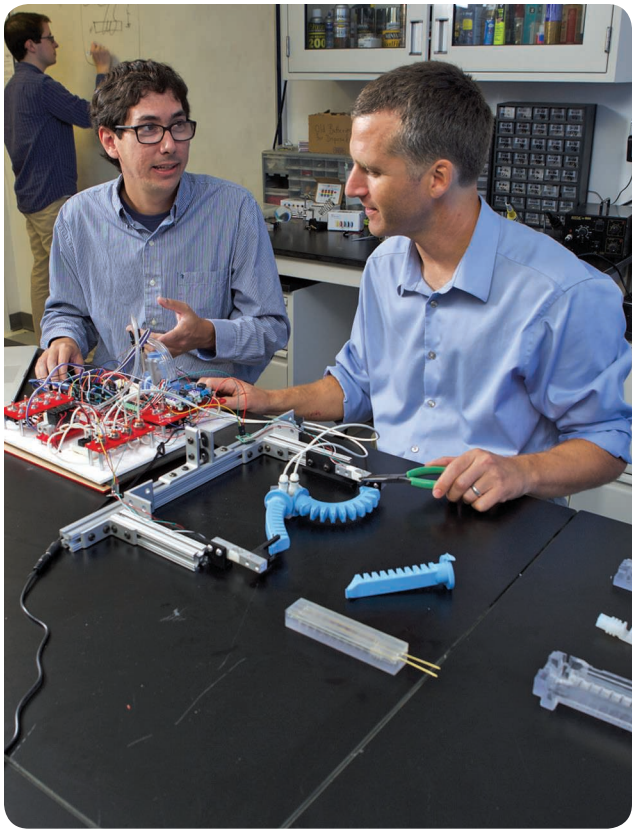
At this point, I had a pretty good sense of what I wanted to work on and what I needed to learn more about: control theory. I was fortunate to work as a graduate student on multivehicle control for ocean sampling, including modeling, simulation, and a major ocean experiment involving many researchers and disciplines. I also participated in a training program in biocomplexity that featured many inspirational studies of collective behavior in animal groups. After five years in industry and five more as a graduate student, I had a favorable view of the intellectual opportunities and independence that are possible in academia.

Q. What are some of your research interests?

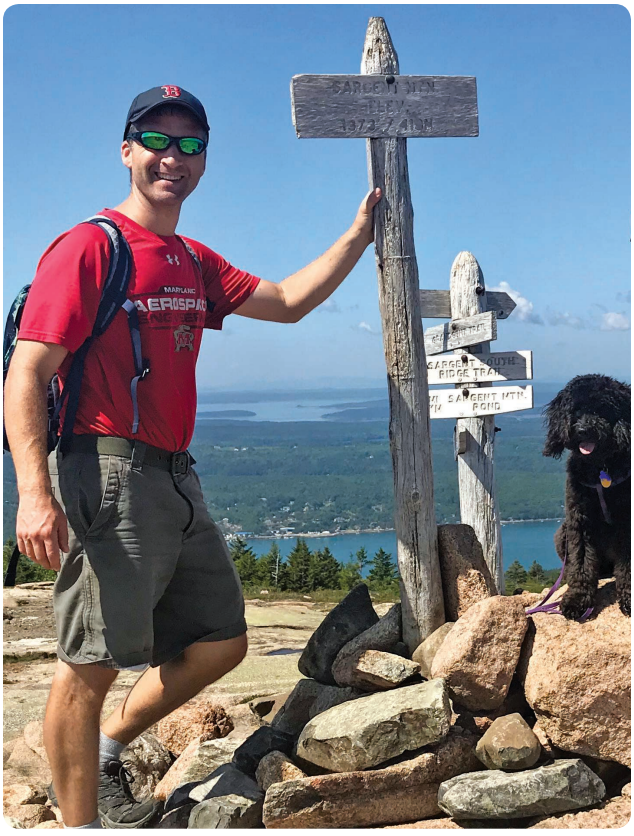
***Derek*:** I started my lab at the University of Maryland with three primary research interests that stemmed from my early experiences and continue to this day: dynamics and control, mobile sensor networks, and bioinspiration/biocomplexity. Modeling, estimating, and controlling dynamical systems forms the foundation of most of my research. I have a long-standing interest in the concept of adaptive sampling, which uses measurements collected by one or more mobile sensor platforms to update a model-based estimate of an unknown spatiotemporal process (which, in turn, guides the collection of subsequent measurements, for example, to minimize a sampling metric such as estimation uncertainty). Generally, my students and I think of this topic as distributed estimation and distributed control, which has applications ranging from aerospace engineering to robotics. For example, we use pressure sensors distributed along an airplane wing to estimate the airflow over the wing and, similarly, pressure sensors distributed along a streamlined underwater vehicle to estimate the fluid flow (which can be used to control the swimming speed and direction of the vehicle). Our ongoing work with a fish-inspired underwater vehicle led us into the field of bioinspired soft robotics, which are typically fabricated from flexible materials and, consequently, have many degrees of freedom. Biological examples that inspire my recent work in soft robotics include caterpillars and starfish—natural systems that have distributed architectures for sensing and actuation. We are also getting closer to creating a school of robotic fish.

Q. What courses do you teach relating to control? How would you describe your teaching style?

***Derek*:** I teach both undergraduate and graduate dynamics and applied nonlinear control, which is a graduate course. I would describe my teaching style as conversational yet rigorous. I lecture by projecting my handwritten



Derek A. Paley (right) discussing his research into the feedback control of bioinspired soft robotics with his postdoctoral researcher, Will Scott.



Derek A. Paley with his dog, Cally, at the summit of Sargent Mountain in Acadia National Park, Maine, in August 2019.

notes, which are generated in real time using my iPad and Apple Pencil. A combination of hands-on demonstrations and YouTube videos keeps my undergraduate students engaged. Students in my graduate courses do a project related to their research that enables them to gain experience in the written and oral communication of technical topics. My course evaluations reflect my high expectations for student understanding of challenging material. In fact, I have won my department's "Broken Propeller" teaching award three years in a row, a rather dubious honor.

Q. What are some of the most promising opportunities you see in the control field?

***Derek*:** With the recent surge of computer science, machine learning, and artificial intelligence, the control field needs to engage in these topics to stay relevant. Autonomous robotics is an opportune topic because many robotic systems are operated open loop. Closing the loop using feedback endows a robotic system with many of the virtues of automatic control: stability, robustness to disturbances, mitigation of unmodeled dynamics, and autonomous operation, with or without human intervention. Robotics has applications ranging from medicine (including ingestible capsules that can collect data and perform treatment inside the human body) to transportation (including self-driving cars and electric vertical takeoff and landing aircraft that may soon carry packages and/or people). I recently started the University of Maryland Autonomous Micro Air Vehicle Team, which competes annually in a student competition at the Vertical Flight Society Annual Forum using a small custom-built quadrotor.

Q. You are the author of a book on dynamics. What topics does this book cover?

***Derek*:** *Engineering Dynamics* is intended to be an introduction to modeling physical systems using Newton's and Euler's laws, based on a foundation in physics, differential equations, and linear algebra. The book starts with single-particle dynamics in the plane, including topics such as momentum, work, and energy, before introducing multiparticle systems and rigid bodies. It then retraces these topics in three dimensions. The University of Maryland has a 15-week semester, so there is enough time for my undergraduate dynamics class to cover 3D rigid-body rotational kinematics and dynamics, including topics such as Euler angles and gyroscopic stability. I also use the book during the first third of my graduate dynamics class before moving on to study Lagrangian and Hamiltonian methods and the dynamical-systems theory of nonlinear and chaotic systems.

Q. What are some of your interests and activities outside of your career?

***Derek*:** During my spare time, I enjoy spending time with my wife, Robyn, and children, Ethan and Adyn. I also enjoy reading, rock climbing, and softball. I recently started playing the acoustic guitar again, when I'm not playing ball with my dog, Cally. We also have two parrots, Tommy and Gandalf the Grey.

Q. Thank you for your comments.

***Derek*:** Thank you for the opportunity to share my experiences and thoughts about controls research and teaching.

Profile of Derek A. Paley

- *Current position*: director, Maryland Robotics Center, and Willis H. Young Jr. Professor, University of Maryland, College Park.
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- *IEEE Control Systems Society experience highlights*: associate editor, American Control Conference (2013 and 2014); associate editor, *IEEE Transactions on Control of Network Systems* (2014–2017); Program Committee member, 2019 IEEE Conference on Decision and Control.
- *Notable awards*: Faculty Early Career Development Award, U.S. National Science Foundation (2010); Presidential Early Career Award for Scientists and Engineers, U.S. Department of Defense (2012); E. Robert Kent Teaching Award for Junior Faculty, University of Maryland (2014); Engineer of the Year, American Institute of Aeronautics and Astronautics National Capital Section (2015).

LORENZO MARIO FAGIANO

Q. How did your education and early career lead to your initial and continuing interest in the control field?

***Lorenzo*:** My first encounter with control engineering was during my B.S. and M.S. studies when completing the Principles of Automatic Control and Automatic Controls courses. I was fascinated by the system-theoretic approach that can be used to analyze and design control systems for a broad range of industrial applications. Thus, I decided to pursue a thesis on vehicle stability control in collaboration with the Fiat Research Center, where I eventually started working as a permanent employee right after graduation. After

Digital Object Identifier 10.1109/MCS.2019.2961731
Date of current version: 17 March 2020