2019 Romeo L. Moruzzi Young Faculty Award for Innovation in Undergraduate Education

Raghvendra V. Cowlagi

Control systems are all around us, modifying the behavior of aircraft, cars, power plants, and more. With its complex mix of mathematical modeling and analysis, algorithms, estimation, and control theory, the teaching of control systems presents considerable pedagogical challenges. Textbooks traditionally use an unrelenting "theory-first" approach, producing steep learning and motivation barriers for many students. Moreover, typical assessments insist on unique "correct answers" that do not reflect the real world.

Since his arrival at WPI in 2013, Raghu identified and confronted these challenges head-on, significantly improving two senior-level controls courses in Aerospace Engineering by providing strong real-world connections to theoretical subject matter. He introduced projects related to realistic missile guidance applications and infused examples and real-world data in assignments. His most noteworthy innovation, however, is the introduction of personalized experiments that students can conduct at home. For example, using smartphones or Arduino kits, students are asked to collect navigational data, like position and time, along a trajectory of their choice, such as a walk across the campus, a drive across the city, or even a flight across the country. That personally relevant data then becomes the focus of discussions and homework assignments as students apply the mathematical techniques and theory they learn in class.

 Because of these approaches, his students have successfully learned advanced concepts, such as Kalman filtering, that are typically reserved for graduate courses. Students say that applying theory to their own data helps their knowledge "stick," and they value seeing tangible representations of work in the aerospace field. One student wrote: "The subject, though challenging, was extremely interesting and reinforced my desire to be an aerospace engineer." These teaching innovations are also being adopted by other faculty with promising results. As one colleague noted, "Seeing Raghu successfully implement take-home experiments has led me to think about revisiting their use in my classes using low-cost instrumentation that has now become available."

For his efforts to overcome the steep learning barriers usually associated with theoretical subject matter and his use of personalized real-world connections to help students succeed, we are proud to present a 2019 Romeo L. Moruzzi Young Faculty Award for Innovation in Undergraduate Education to Professor Raghvendra V. Cowlagi.