Teaching Statement

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Ensuring students can extend fundamental principles from the classroom to practice is a primary goal of teaching engineering. To foster this, students must understand the real-world significance of the lecture material and be provided the opportunity to actively participate in their education. During my undergraduate and graduate studies, I found that classes accompanied by laboratory work or course projects were more engaging than lectures alone and allowed students to work on tangible projects that brought core concepts to life. Stimulating students by participation in engaging and applied activities can motivate them to independently probe deeper into the subject without additional incentive. This approach to learning-through-doing continues to shape both my teaching and research philosophies.

Teaching Philosophy

I will strive to be an educator who excites the curiosity in students and creates an environment that develops them into future researchers and technological leaders. To initiate the curiosity, the curriculum I will construct shall develop a theoretical foundation while challenging the students to apply their newfound knowledge to practical problems. Implementing this curriculum requires a multi-tier approach to teaching and advising.

In the foundational tier, I intend to ensure undergraduate students develop a firm understanding of the fundamental concepts. To ensure their comprehension, I shall explain difficult-to-understand core concepts using visual analogies and physical demonstrations, such as explaining an electrical second-order system response using a mechanical spring-mass-damper system. Through simply analogies, the fundamental concepts will be instilled in their basic understanding of the surrounding physical world, allowing for easier comprehension. As their education progresses, I will continue to help guide students in their undergraduate studies. Given my prior teaching and research background, I am well suited to teach a broad range of topics covering basic circuit theory, signals and systems, embedded controls, and mathematics for engineers. I am especially interested in developing and contributing to undergraduate courses containing a laboratory component since my undergraduate education was significantly enriched by applying classroom theory on physical devices.

Once the foundational tier has been developed, my educational role, as pertaining to graduate students, becomes a balance between the roles of teacher and advisor. For graduate students, the curriculum aims to provide breadth within a specific field of study while instilling the skills and mathematical tools necessary to understand, formulate, and solve research problems. Within this tier, students will be challenged to identify and address practical research problems. This is achieved by designing graduate-level courses that not only teach the required theory, but also require an application of the theory through a course project or laboratory component. At this stage, it is essential that students develop their own ideas and my role is to encourage their creativity while supplying basic direction.

The highest tier within my teaching philosophy is reserved for doctoral students. As opposed to developing their foundational understanding, my role as an advisor is to identify and encourage the individual aspects of each student that will prepare them for a future of collaboration with experts in the field to produce new research problems and technologies. I will challenge my students to always identify the practical importance of their work and, when possible, to demonstrate their solutions through implementation and experimentation. To ensure the brightest possible future for my doctoral students, I will guide them to publish in highly referred conferences and journals to increase their publicity and impact within the research community.

Future Teaching Plans

My future teaching plans involve instructing both undergraduate and graduate level courses as discussed in the following subsections, respectively.

Undergraduate Courses: As faculty, I would like to teach the following undergraduate courses:

- ***Embedded Control Systems***: This course introduces principles for design of embedded controllers and emphasizes practical insight into the tools for modeling and simulating these dynamic physical systems, and methods for designing the real-time software for embedded computers to control them. Lectures cover relevant theory and background from real-time systems and control engineering, including event-based and clock-based sampling, switching control, PWM (pulse-width modulation), PID (proportional-integral-derivative) design, state-variable feedback, state estimation, and methods for set point control and trajectory tracking. Basic embedded computing,

sensor, and actuator technologies are reviewed, including micro-controllers, DC motors and optical encoders. In the laboratory, students use commercial tools for simulation and automatic code generation to design and implement embedded control system experiments.
- ***Signals and Systems***: This course develops the mathematical foundation and computational tools for processing continuous-time and discrete-time signals in both time and frequency domain. Key concepts and tools discussed in this class include linear time-invariant systems, impulse response, frequency response, convolution, filtering, sampling, and Fourier transforms. The course provides background to a wide range of applications including speech, image, and multimedia processing, bio and medical imaging, sensor networks, communication systems, and control systems.

Given my teaching and research background, I would be able to teach undergraduate courses in the following areas:
- **Mathematics for Engineering**: This includes the topics of linear algebra, probability and statistics, and linear circuit analysis that forms the foundation of any electrical and computer engineering degree.
- **Controls**: Topics that include material covering continuos-time feedback control and digital control systems.

Graduate Courses: Within my graduate-level teaching, I would like to introduce two new graduate/advanced-undergraduate courses:
- **Fundamentals of Cyber-Physical Control Systems**: This advanced course focuses on introducing the fundamental tools required to design, analyze, and implement cyber-physical control systems. Cyber-Physical Systems (CPS) represent a new era of safety-critical embedded systems that feature tight coupling between communication and computation used to control complex, uncertain, and potentially adverse physical plants. These systems are common in many critical infrastructures including healthcare, energy, transportation, and manufacturing. In this course, an emphasis will be placed on designing control systems which can tolerate real-world uncertainty inherent in CPS. Case-studies on CPS applications will be employed to demonstrate the performance of current state-of-the-art technologies. Students will be encouraged through a course project to investigate a self-chosen cyber-physical control application.
- **Automatic Control of Physiological Systems**: This graduate or advanced-undergraduate course introduces control engineering students to physiological systems. This course consists of three parts. The first part focuses on modeling physiological systems in a manner suitable for control. Students will become familiar with translating clinical relations, which are typically static in nature, into dynamic systems. The second module introduces techniques for addressing challenges arising from physiological uncertainty inherent in closed-loop physiological systems. In the final portion, students perform a physiological control or monitoring project of their choice using clinical data from the available databases (e.g, PhysioNet, MIMIC II) and, when applicable, demonstrate their systems on real medical devices within my lab.

Given my background, I would be able to teach the following graduate level courses:
- **Controls and Optimization**: Topics that include material covering optimal control, robust control, non-linear control, optimization methods, and convex optimization.
- **Stochastic Systems**: Graduate-level topics including estimation, detection, and identification in both Bayesian and non-Bayesian frameworks including the advanced topics of sequential detection, parameter invariance design, and decentralized signal processing.