Statement on teaching and mentorship

Teaching experience

I greatly enjoy teaching and mentorship. Throughout my PhD, I have served as a teaching assistant (TA) for five courses at Caltech:

- Introduction to Feedback Control Systems (CDS 110), Instructor: J. Seinfeld, Spring 2021
- Network Control Systems (CDS 141), Instructor: J. Doyle, Spring 2020
- Robust Control Theory (CDS 231), Instructor: J. Doyle, Winter 2020/Winter 2022
- (Head TA) Relational Databases (CS 121), Instructor: M. Hovik, Winter 2021
- Introduction to Distributed Algorithms (CS 142), Instructor: K. M. Chandy, Fall 2021/Fall 2022

For all courses, I held office hours, conversed with and guided students, and participated in rubric creation and grading. For seminar-style courses (CDS 141, CDS 231) taught by my advisor, I ***planned and gave several lectures*** based on established material and also my own research topics. For CDS141, I ***designed a course project*** to familiarize students with a distributed controls toolbox. As head TA of CS142, I worked on automatic grading, and coordinated student evaluation with a team of 8 TAs. I consistently receive high student evaluations (5/5 for helpfulness, clarity, preparedness, and effectiveness) from course reviews. Examples of student feedback include:

"Thanks for being a great TA! Your engagement and enthusiasm made this class all the better."

"She provided helpful guidance during office hours and useful feedback on homework assignments, which I appreciated."

Mentoring experience

In 2021, I had the joy of co-mentoring Josefin Stenberg, a masters student from KTH who was visiting Caltech as a summer student. Our work on extending standard control theory to incorporate delays culminated in two papers, which we jointly presented at the 2022 American Control Conference [2,3]. For this project, I provided guidance on technical details and broad motivation, in order to help Josefin gain a deeper understanding and appreciation for what can be achieved using control theory. I also provided feedback and suggestions for writing and verbal presentations.

From 2020 onwards, I mentored Lauren Conger, a junior student in my lab. In her first year, we chatted weekly about advisor selection, coursework, and fellowship applications; I provided feedback on Lauren's research proposals, which eventually earned her the competitive NDSEG fellowship. Later on, I gave guidance on research, including technical details, good writing habits, and presentation skills. We have written one paper together, which will be presented at the 2022 Conference on Decision and Control [1].

Aside from technical research activities, I have also mentored junior students through Caltech's international programs and diversity programs, with whom I've discussed various aspects of PhD life.

Teaching philosophy

Student understanding of course material is heavily dependent on quality of presentation. I take pride in delivering lectures and talks that are ***clear and easy-to-follow***. I have received positive feedback to this effect from students and research audiences alike. Additionally, I find the following important:

Context and motivation via real-world applications. Education equips students to work on and solve problems in the real world, which is not neatly partitioned into course-sized topics. Thus, though concepts and equations are elegant, they should not be the only things students take away from a course – students should also understand how these concepts are related to others in the field, and how they can be used in the real world. As a teacher, I aim to provide appropriate context and motivation to my students by

discussing real-world applications. This increases the utility of the course for students, and also increases student interest and engagement. I have experienced this firsthand; as an engineering freshman, I disliked (and failed to fully grasp) linear algebra, whose motivations and practical uses were not discussed. However, when I next encountered linear algebra, it was in the context of systems control and its many exciting applications – then, I was much more motivated to engage with, appreciate, and master this elegant mathematical tool. As a teacher, I aim to provide appropriate framing and motivation.

Participation and engagement. Attending lectures should provide unique value-added for students – they should be engaging and promote understanding. Appropriate pacing is important; when possible, I enjoy ***whiteboard-style teaching***, which lets me work on problems with students in real-time and show the strategies and thought processes in an organic way. I also like to use group voting (e.g. "raise your hand if you think x is true") as a low-stakes way to gauge understanding and encourage participation; this also ***emboldens students to participate*** in other ways (e.g. suggesting answers) or ask questions.

Teaching interests

I can teach many electrical/mechanical/computer engineering courses at the introductory level, including ***calculus, classical mechanics, computer systems, intro to programming, relational databases***, etc. The courses that I am most excited about are ***linear algebra*** and ***linear systems and control***. I am also interested in teaching advanced courses such as ***real- and discrete-time control, distributed control,*** and ***model predictive control***. Additionally, I would love to offer interdisciplinary and topics courses:

- ***Control + dynamical systems for biologists (and other non-engineers)***
  Control theory offers unique insights for many branches of science, but can be daunting and inaccessible to non-engineers. This course aims to teach non-engineers the basics of control theory and how it can be applied to research in biology and other domains of interest
- ***Architectures, control theory, and biology***
  Topics course on various ways of applying control theory and architectural theory to various fields of biology, including sensorimotor modeling, metabolic modeling, and immune modeling

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Mentoring and advising philosophy

The goal of doctorate-level study is to be able to identify areas and problems that are interesting, useful, and challenging; to appropriately frame the problem; and to apply techniques to solve the problem. For masters- and undergraduate-level research, more emphasis is placed on the latter. In all cases, ***a good advisor tailors their mentorship style to the current needs of their advisee***. For masters, undergraduate, and early-year PhD students, I plan to offer more hands-on guidance, pointing them to appropriately framed problems; for these students, the goal is to become acquainted with the research process and necessary tools. As PhD students progress in their degree, I will play less of a role in problem framing, and instead focus on helping the students find their own problems and frame them in their own way. Additionally, ***a supportive and collaborative environment is essential to a productive and rewarding PhD***. I will endeavor to facilitate such an environment with regular meetings and both academic (e.g. group seminars) and non-academic lab activities (e.g. group lunch, happy hour, game night), and also encouraging cross-lab collaborations where applicable.

[1] L. Conger, **J. S. Li**, E. Mazumdar, S. L. Brunton, "Nonlinear System Level Synthesis for Polynomial Dynamical Systems", to appear at *IEEE Conference on Decision and Control*, 2022 [pdf]

[2] J. Stenberg, **J. S. Li**, A. A. Sarma, J. C. Doyle, "Internal Feedback in Biological Control: Diversity, Delays, and Standard Theory", in *IEEE American Control Conference*, pp. 462–467, 2022 [pdf]

[3] A. A. Sarma, **J. S. Li**, J. Stenberg, G. Card, E. S. Heckscher, N. Kasthuri, T. J. Sejnowski, J. C. Doyle, "Internal Feedback in Biological Control: Constraints and Layered Architectures", in *IEEE American Control Conference*, pp. 456–461, 2022 [pdf]