

# Teaching Statement

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“Relax! Walk with the ball!” I lost count how many times I heard that from my Brazilian soccer coach, Zito. Soon it became a part of me, not just something I knew. He along with others have influenced me on my journey. I not only want to know what they know, but in many ways I want to be like who they are: one who motivates, teaches, leads, encourages and inspires. My grandfather, a retired rocket scientist, gave me a vision for space exploration and taught me to enjoy my labors. An industry mentor during my time at Stanford, Lars Karlsson, taught me the importance of critical thinking and asking the right questions when problem solving. He was able to answer many problems by just asking the right question. One of my Stanford advisers, Bob Twiggs, director of the Space Systems Development Laboratory, was the creative force behind the CubeSat program, which has enabled universities around the world to develop space research programs. His spark has ignited the imaginations of students and motivated agencies such as DARPA and AFRL to provide increased funding. A university faculty position offers the opportunity to be this type of inspirational teacher exemplified by my mentors.

## I. Teaching Philosophy

Through my experiences in teaching graduate-level spacecraft design classes and advising multiple students during independent research projects, I have developed three themes that pervade my teaching. First, most modern engineering projects require a systems approach to manage their complexity and multidisciplinary nature. During my undergraduate and graduate careers, this was not part of the core curriculum. I was forced to learn it on my own as a systems engineer for several satellite design projects. Students need a method for obtaining a holistic view of the system they are designing in order to understand the particular implications of their component design. My future classes will contain elements of systems engineering such as requirements development, modeling, simulation, analysis, testing, and team management. I will create an environment to support multidisciplinary projects and research. At the heart will be a research center that ties in research and teaching efforts of multiple professors developing space and aerospace informational technologies. I did this at Stanford while combining the research efforts of two laboratories in different departments and enabled cross-fertilization of research ideas.

A second theme is that system performance is no longer the primary design driver. There has been a shift in development of computing and informational systems to other system attributes including availability, manageability, agility, and scalability. It’s not good enough for systems to run quickly, they must run well. My primary focus is availability and building robust systems. In the next section, I talk about a specific class focusing on improving system-wide availability.

My third theme is that students need to learn independent thinking and problem solving. Engineering design projects are not homework assignments with well-defined boundaries; they exist in the real-world where requirements creep, environments change, and complex interfaces are to be expected. My classes will be project-based, building off the depth of core engineering classes to provide breadth in the multifaceted, multidisciplinary nature of design problems. The projects will be team-based to teach students how to survive/cope/thrive in a design team. The goal will be the training, not just the teaching, of students to enable them to build modern, complex systems where they learn through first-hand experiences and mentoring.

## II. Teaching Interests

My educational career has prepared me to teach a variety of subjects encompassing a hybrid of electrical, computer, and aerospace topics. With a core education in electrical/computer engineering, I applied and extended computer science mechanisms to improve the capabilities of aerospace systems. Thus, my teaching

interests cover a spectrum and are often multidisciplinary. They include and are not limited to the following:

- **Core Electrical/Computer Engineering Classes:** I would enjoy teaching core ECE classes and laboratories such as analog circuitry design, digital circuit design, signal processing, networking, communication, information systems, programming, fault-tolerant systems, control theory, electromagnetics, semiconductor physics. These classes are a foundation for many engineering disciplines. There is a growing need for engineers of all types to have breadth in training that includes these topics. As an electrical engineer working in aerospace and computer science laboratories, I often heard, "You're an electrical engineer, so you know about X. Tell me about..." where X could be any of the above topics. I became quite good at explaining electrical engineering foundations to people with non-EE backgrounds. My goal is to teach these core classes not only to provide the depth to specializing students, but also to provide the breadth needed by multidisciplinary student bodies who will face modern and complex systems.
- **Core Aero/Astro Classes:** Due to the application of my research to aerospace systems, I am comfortable teaching multiple Aero/Astro classes. These include controls, statics, dynamics, space mission design, spacecraft design and control, and information technology related classes.

Derived from my research activities, there are several specialized classes I am eager to teach as well. These include the following:

- **Space System Design:** The dream of a space age has recently been rekindled by private endeavors such as the X-Prize winner, Burt Rutan and his SpaceShipOne. Space exploration is no longer solely the realm of governmental institutions, but is within the reach of private citizens. My goal is to train the next generation of space engineers and enable them to reach for the endless possibilities in space tourism, industry, colonization, and experimentation. My experiences at Stanford building nine university-class satellites and operating them in low-Earth orbit have prepared me to develop the required curriculum and laboratory infrastructure. I expect to partner with other professors to build a laboratory with the depth of expertise to address all aspects of space systems such as information systems, orbital dynamics, propulsion, and life-support. The core will be a class project involving end-to-end mission design and full life-cycle operation of a space system such as a satellite. This will provide students with hands-on experience in requirements formulation, design development, functional testing, and on-orbit operations. Project teams will be student-led and multidisciplinary. The curriculum will provide depth in systems engineering, the space environment, and design techniques. Working with global colleagues I met during my graduate work, I'll seek international collaborations for project teams to expose them to international partnerships. The future is promising for space exploration, and it is my goal to be on the leading edge of it through my research and my training of future engineers and astronauts.
- **Reliable Systems:** Failure is a fact in modern systems where complexity and sheer size prevent even the most carefully designed systems from flawless operation. Notable computer system researchers such as David Patterson, Jim Gray, and John Hennessy are shifting the focus of research from increasing performance to improving availability, manageability, agility, scalability. It has been my experience that traditional fault-tolerant and reliability classes focus on lower-level failures such as chip errors and bit flips. My goal is to extend these vital classes and develop a course on system-level reliability that will teach architectural principles for robust system of systems. The core material will be case studies from which principles can be drawn for broader application. It will be project-oriented where student teams will apply these principles to relevant systems. The emphasis will be on information systems for Internet, aerospace, medical, and automotive applications. The primary purpose of the class is to make availability a first-order design objective for future engineers.