Statement of Teaching Philosophy and Practice
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Over the past eight years, my teaching efforts have been primarily dedicated to the areas of electromechanics and power electronics. At UM-Rolla, I was responsible for undergraduate and graduate courses in electric machinery and the undergraduate course in power electronics. I also coordinated the undergraduate electric machinery laboratory and developed the Ameren power electronics laboratory. At Purdue, I am responsible for the senior-level power electronics course, the graduate-level core course in energy conversion, and have developed a new freshman-level course that introduces students to fundamental concepts within the multiple areas of electrical and computer engineering.

I believe that there are few areas better than electromechanics and power electronics that serve to demonstrate to students that the multiple areas of electrical engineering, which they may perceive as unrelated, come together as these systems are developed. Designing electric drives and power electronic circuits requires knowledge of semiconductor devices, passive elements, and controllers. Fundamental understanding of each must be integrated with knowledge of the behavior of electromagnetic fields, electric machinery, modeling techniques, controller design, and microprocessor implementation in order to create efficient designs.

In my teaching, I have placed a focus on creating course content that helps to link these multiple areas and hone students’ analytical and design skills. To help link seemingly unrelated areas, I present students with a concept that their education is creating their engineering toolbox (much like a mechanic’s toolbox that contains many different tools). I ensure students exercise these tools using design problems and comprehensive homework assignments. As tools are developed I place a strong emphasis on an engineering methodology in which students 1) analyze a system to establish expected results; 2) simulate to verify the analysis; 3) validate through hardware experiments. To support the hardware experiment I have obtained roughly $300K in funding from the National Science Foundation and corporate sponsors to develop electromechanics and power electronics laboratories. Innovative software and hardware has been developed by myself and my students and has been distributed nationally. These are documented in a paper in IEEE Transactions on Engineering Education [1].

Overall, students have responded well to my methods. Feedback and teaching evaluations have been very strong. Perhaps most important, many undergraduates have become interested in careers in energy systems as a result of these efforts. In the past eight years, I have attracted (and funded) 16 talented undergraduates as research assistants. The average GPA of these students is ~3.85/4.0. Nine of the sixteen have decided to attend
graduate school in the energy systems area, and six have or are pursuing PhDs. One has received the NSF Graduate Fellowship, and five are NSF IGERT Fellows.

In recent years, I have attempted to expose more students to the exciting fields of electromechanics and power electronics through support of international student competitions. Specifically, from 2001-2005, I was a leader in the International Future Energy Challenge (IFEC), which is an undergraduate student design competition with a focus on energy-related topics. Through development of topics and design performance guidelines, the IFEC has created projects that are being used worldwide in senior-level design courses. Students build and test hardware and compete with schools from around the globe. I believe that such design competitions can provide the cornerstone of future engineering education by introducing students to engineering problems facing the world and also exposing students to international competition.

To support graduate education, I have worked in collaboration with Dr. Scott Sudhoff to construct a reduced-scale next generation shipboard power system [2]. The system contains numerous dc-dc, dc-ac, ac-dc converters, generators, and motor drives. Since we designed all of the components, parameters and controls are well documented. The facility provides our graduate students, and the research community at large, with a thoroughly documented nonproprietary system on which to demonstrate advanced controls and validate CAD tools. The Office of Naval Research (ONR) has adopted the testbed to issue national challenge problems in controls-related research.
