Statement of Teaching Contributions

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Based on my previous and current teaching experience at the University of Auckland and EPFL, I would be comfortable developing and delivering courses on the following topics:

- senior-undergraduate/masters level: radio and communication systems, signal processing, and electromagnetics; and
- second/third year undergraduate level: electronics, circuit analysis, and digital/analog design.

This list is not exhaustive and I would be happy to provide further details if required. In the following sections I will outline some of the teaching contributions that I can make, particularly with respect to innovation in delivery and content.

Course Delivery

Courses in electrical engineering must provide an appropriate integration between: lectures (used to establish structure and emphasise key points), tutorials and problem sets (used to provide practical experience in problem solving), and laboratory sessions (used to teach and develop experimental skills). I place particular emphasis on the importance of learning to think about relationships and trends, rather than rote memorisation of formulas or derivations. Well designed and integrated courses help students develop these critical thinking skills.

I also try to integrate experimental demonstrations and computer-based visualisations into my lectures, as electromagnetics and wireless communications can be very abstract subjects and engineering insight is often obscured by the mathematics. Often 'seeing' the field distributions or the signals provides the missing link between the mathematics and the solution to a problem. For example, I have used a simplified version of the two-dimensional finite-difference time-domain method to introduce Maxwell's Equations by showing how the magnetic and electric fields are related in space and time. Similarly, I have used visualisation techniques developed from my research (Poynting vector streamlines) to qualitatively show examples of diffraction and scattering.

Online study and assessment tools—such as the OASIS system developed by the Department of Electrical and Computer Engineering at the University of Auckland, and the Moodle system at EPFL—are increasingly being used for course delivery. When used appropriately, these tools can jointly satisfy the needs of students and educators. Well designed questions allow students to improve their skills and problem solving techniques by providing instant feedback. For educators, the pattern of responses to particular questions can be used to quickly identify misconceptions and take steps to correct them. For example, after examining the answers submitted by students for a series of questions on designing single-stub matching networks using Smith Charts, it was clear that many in the class remained unsure about which direction to rotate the loads. I was thus able to address this point directly in the next tutorial, before moving onto the more complicated double-stub matching procedure.

Research-based Teaching

While the primary aim when designing and delivering a course in electrical engineering is to provide students with sound grasp of the scientific principles of the subject, it is also important to address the current engineering applications of the material. Research-based teaching can also help students generalise from the specifics that were taught in the course (and others) to topics not previously encountered. For example, while teaching courses and tutorials on fundamental electromagnetics I 'seed' the idea that the permittivity and permeability do not have to be positive. In subsequent lectures I expand on this to introduce the students to metamaterials and show some of my own simulation results for propagation through negative refractive index media. A number of students commented during the course and afterwards that the inclusion of 'cutting-edge' research examples gave them a better appreciation for the subject.

I am particularly keen on incorporating a research project component into my senior level courses. I find well designed projects can help students to develop practical engineering and research skills—such as independently investigating new ideas, critical thinking and problem solving, and effectively communicating their findings through written reports and oral presentations. For example, at EPFL I designed a new project for a masters-level course on wireless systems, where the students had to choose several receiver architectures from the literature and implement these on a research test-bed to evaluate the performance under realistic wireless channel conditions. In addition to reinforcing the concepts taught in the course and developing experimental skills, the project also required the students to investigate design trade-offs and alternative ideas proposed in the literature.