Wireless Power Transfer

This course surveys wireless power transfer technology, with a focus on electromagnetic methods, both far field [long range, low power] and near field [short range, high power]. The course is organized around descriptions of wireless power transfer systems, presenting the relevant electromagnetic concepts as they are needed for each application.

For near field systems, we will describe conventional inductive and resonant wireless power transfer systems. We will discuss multi-hop wireless power transfer, and automatic tuning (both frequency and impedance tuning). We will discuss transmit amplifier designs.

In far field systems, we will describe rectification, power optimized waveforms, and approaches to beam forming.

Throughout the course, we will review the relevant electromagnetic concepts as they arise in the context of various wireless power applications. We expect to touch on (1) lumped circuit quantities (resistance, capacitance, inductance, mutual inductance, impedance) as quasi-static limiting cases of Maxwell's equations (2) resonance (3) quality factor (4) normal modes (5) transformers (6) impedance matching (7) antennas, including far field and near field behavior (8) electromagnetic materials, in particular lossy media, and the use of high permeability low conductivity materials (ferrite) in wireless power transfer. We will also discuss diodes, rectifiers, voltage multiplier circuits, and rectennas.

The course will include several Lab activities, and a final project involving design or analysis of a wireless power transfer system or an RF energy harvesting system.

Prerequisite Knowledge: Undergraduate electromagnetism

This is a completely new course that has never been offered before, so some of the details are likely to change.