

EE 574 (Antenna: Analysis and Design), Autumn 2023

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Class schedule: Mon/Wed 2:30-4:20 PM

Introduction and Objectives:

Antennas are the eyes and ears of any wireless system, which are ubiquitous, and their contribution to our daily life is exponentially expanding by emerging new technologies like IoT and VR headsets. These wireless systems cannot properly operate unless they utilize transmitting and receiving antennas to efficiently radiate the electromagnetic waves that carry information. Moreover, antenna arrays give us full control of the shape and direction of radiation patterns. This feature of antenna arrays is the most crucial element in the combat radars that allow simultaneous detection and tracking of multiple adversarial targets. Furthermore, reflector antennas are essential parts of radio telescopes that look deep into space for astronomical studies like black hole imaging. These are just a few examples of the vast applications of antenna systems.

The goal of EE 574 is to provide a hands-on introduction to antenna design, simulation, and measurements. We will start with the basics of antenna theory and conclude by reviewing some of the fascinating practical applications of antenna systems, like the ALMA radio telescope.

Prerequisites:

Applied electromagnetics (EE 361) and fundamental electrical engineering circuit analysis (EE 215 and EE 233)

HWs and Labs:

There will be five graded HWs plus a final design project, including designing and simulating a planar antenna in Ansys HFSS software. We will teach students how to work with the Ansys HFSS software during office hours. Then, we will go through the fabrication and measurements of each antenna project to compare the simulation and measurement results. The final projects will mainly focus on the variants of microstrip antennas; however, if you are involved in any research project that needs an antenna design, you are welcome to define it as your final course project with some revisions to be consistent with the workload of other groups.

Tentative Course Topics:

- 1- Fundamental antenna parameters: radiation pattern, polarization, directivity, gain, antenna impedance
- 2- Wire antennas: dipole, monopole, folded dipole, loop antenna
- 3- Antenna array: broadside array, endfire array, phased array, planar array
- 4- Microstrip antenna: cavity model, transmission line model
- 5- Aperture antenna: horn antennas, slot antenna, Babinet's principle
- 6- Review of reflector and lens antennas

Grading Policy:

The final grade will be based on the project report and the graded HWs. **This course doesn't have a final exam.**



Antenna array of an APG-80 radar installed on an F-16 Fighting Falcon.



ALMA radio telescope is the largest telescope in the world utilized for black hole imaging.