SENIOR RESEARCH PROJECT
Title: Flight Planning
Supervisor: Prof. Margaret Cheney

Description: Radar imaging often uses data from an antenna mounted on a moving airplane, and the resolution of the radar image depends on the flight path of the airplane. The resolution is characterized by the size of a certain two-dimensional set of points, called the data collection manifold. The project is to determine what flight paths give rise to the largest data collection manifold.

Approach: A way to get started is to try various flight paths and work out the resulting data collection manifold. This will provide useful information, and could provide insight that would lead to the development of mathematical methods, such as an optimization algorithm, for determining optimal paths. A number of different imaging algorithms can be investigated with the same approach.

Background needed: Understanding of curves and surfaces in space, such as obtained in Multivariable Calculus or Advanced Calculus. Computing background would be helpful.

SENIOR RESEARCH PROJECT
Title: Waveform Design for Array Antennas
Supervisor: Prof. Margaret Cheney

Description: Digital signal generators can now produce almost arbitrary waveforms, and these waveforms can be fed to antennas which then radiate an electromagnetic field into space. If different waveforms are simultaneously fed to different antennas, which then radiate simultaneously, what does the resulting radiation pattern look like? Can such a distributed antenna transmit different messages in different directions? How can we understand the relationship between antenna position, the waveform fed to the antenna, and the field radiated from the set of antennas? This is a high-dimensional problem, and is of potential importance in secure communications.

Approach: First simulate the field from a collection of point-like antennas activated with different waveforms. The numerical simulations will likely suggest hypotheses that can be verified mathematically. An interesting issue to investigate is the robustness of the results when small errors are made in antenna positioning.

Background needed: Multivariable calculus, linear algebra, and computational experience