New Course Announcement

"The Fourier Transform and Its Applications in Imaging"

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To be offered Spring Quarter, 2020

There is an ever-increasing interest in the techniques, tools and technology in imaging. Important fields such as biology, medicine, autonomous vehicles, satellite reconnaissance, smart phones and astronomy, to name a few, rely heavily on the new imaging modalities offered by modern technology. At the core of these new technologies are the fundamental principles contained in the frequency-domain analysis afforded by two-dimensional Fourier transform theory. The purpose of this course is to provide a broad and deep understanding of the techniques and principles of Fourier analysis, first in one dimension, and then apply them to the analysis of two-dimensional imaging systems. This will give students an in-depth exposure to the principles and applications of the Fourier transform in one and two dimensions in both space and time and then apply them to standard and modern imaging systems. These will include simple diffraction theory from apertures and objects, gratings, imaging, spatial filtering, radiotelescope arrays and, depending on interest and available time, holography and/or computed tomography.

Apart from the emphasis on imaging, the student will gain a good understanding of the powerful techniques that use the tools of Fourier analysis and this will, in turn, prepare them for any of the myriad courses in which Fourier analysis is used. Such courses might include:

- Analog and digital signal processing.
- Communications theory (modulation, noise, etc).
- Solid state physics.
- Optics.
- Astronomy.
- Biomedical imaging.

Reading: Course notes related to the lectures and recommended supplemental texts *"The Fourier Transform and its Applications"* by R. N. Bracewell (McGraw-Hill) and *Fourier Optics* by J. W. Goodman.

Grading: (Subject to revision) Weekly homework (30%). Midterm exam (35%). Final exam (35%).

Course number: EEC189_ (suffix to be determined). Units: 4

Target audience: Junior/Senior undergraduates and graduate students in science and engineering.

Prerequisites: It is suggested that students have had some exposure to wave propagation (as in undergraduate electromagnetics in a physics course) and calculus. Exposure to complex numbers is also handy.