SIO 207A - Fundamentals of Digital Signal Processing

Fall 2021 - Syllabus

Digital signal processing is an important field with applications in ocean sciences, communications, seismology, medical analytics, and related areas. In this introductory course, we will discuss discrete-time signals and systems, discrete-time Fourier transform (DFT) and window functions, fast Fourier transform (FFT), design of finite impulse response (FIR) and infinite impulse response (IIR) digital filters and their implementations, finite word length effects, as well as applications to data acquisition and analysis.

Summary of topics discussed:

1. Discrete-time signals and systems; sampling of continuous-time signals
2. The z-transform
3. Discrete Fourier transform (DFT); window functions
4. Fast Fourier transform (FFT)
5. Digital filter design techniques (FIR and IIR digital filters)
6. Finite word length effects

Students graduating from SIO 207A will be able to:

- Use the z-transform to solve difference equations and to determine the response of discrete-time linear shift-invariant systems to known inputs
- Design and implement digital filters as well as window functions and apply them to a variety of datasets
- Visualize, analyze, and process digital signals in time and frequency domain using Matlab or Python

Time and place: Lectures are on Mondays and Wednesdays 2:00PM – 3:20PM in SPIES 330.

Instructor:

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Course Website: Handouts and homework assignments will be posted on the Canvas website.

Prerequisites: The minimal suggested prerequisites for the course are a background of advanced calculus, along with a good understanding of the elements of complex numbers and variables. An exposure to linear system theory for continuous-time signals, including Laplace and Fourier transforms is helpful, but not required.

Bibliography: This course is based on lecture notes developed by Prof. Bill Hodgkiss. A main reference is the textbook

- *Discrete-Time Signal Processing*, Alan V. Oppenheim and Ronald W. Schafer, Prentice Hall, 2009.

Additional references will be posted on the course website.

Grades: No exams will be given. Grades will be assigned based on the weekly homework assignments and the mid-term/final projects. The homework assignments count 30%, the mid-term project counts 30%, and the final project counts 40%.

Research Project: A mid-term and a final project will be assigned. These projects should represent individual effort, i.e., should be considered as take-home exams.

Homework: Problems to be solved in Matlab will be posted approximately every 1-2 weeks on the course website, and will be due one week later.

Office Hours: Office hours are every Friday at 3 PM via Zoom.

Collaboration Policy: The goal of homework is to give you practice in mastering the course material. Consequently, you are encouraged to form study groups to discuss the course material and problem sets. However, the developed homework solutions, should reflect your own understanding of the course material. The mid-term and final project should represent individual effort and assistance should not be given nor received from anyone other than the instructor.