

Learning Objectives

- ▶ Intro to Electrical Engineering via **Digital Signal Processing**.
- ▶ Develop initial understanding of **Signals and Systems**.
- ▶ Learn **MATLAB**
- ▶ Note: Math is not very hard - just algebra.

DSP - Digital Signal Processing

Digital: processing via computers and digital hardware we will use PC's.

Signal: Principally signals are just functions of time

- ▶ Entertainment/music
- ▶ Communications
- ▶ Medical, ...

Processing: analysis and transformation of signals we will use MATLAB

Outline of Topics

- ▶ Sinusoidal Signals
- ▶ Time and Frequency representation of signals
- ▶ Sampling
- ▶ Filtering
- ▶ Spectrum Analysis
- ▶ MATLAB
 - ▶ Lectures
 - ▶ Labs
 - ▶ Homework

Sinusoidal Signals

- ▶ Fundamental building blocks for describing arbitrary signals.
 - ▶ General signals can be expressed as sums of sinusoids (Fourier Theory)
- ▶ Bridge to frequency domain.
- ▶ Sinusoids are *special signals* for linear filters (eigenfunctions).
- ▶ Manipulating sinusoids is much easier with the help of complex numbers.

Time and Frequency

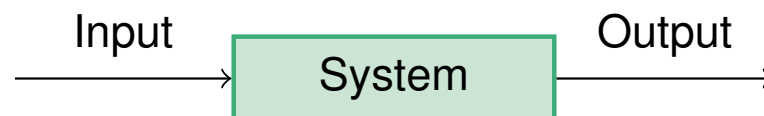
- ▶ Closely related via sinusoids.
- ▶ Provide two different perspectives on signals.
- ▶ Many operations are easier to understand in frequency domain.

Sampling

- ▶ Conversion from continuous time to discrete time.
- ▶ Required for Digital Signal Processing.
- ▶ Converts a signal to a sequence of numbers (samples).
- ▶ Straightforward operation
 - ▶ with a few *strange* effects.

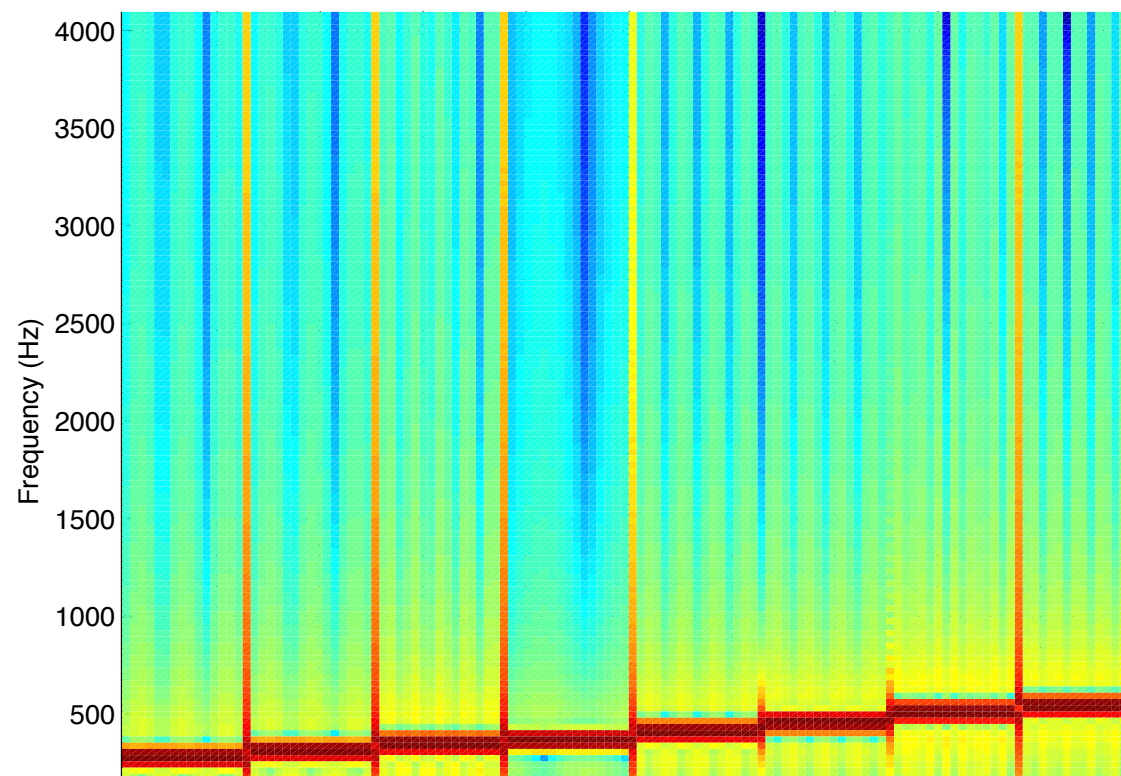
Filtering

- ▶ A simple, but powerful, class of operations on signals.
- ▶ Filtering transforms an *input signal* into a more suitable *output signal*.
- ▶ Often best understood in frequency domain.



Spectrum Analysis

- ▶ Analyze a given signal to find which frequencies it contains.
- ▶ Fourier Transform and fast Fourier Transform
- ▶ Spectrogram



Relationship to other ECE Courses

- ▶ Next steps after ECE 201:
 - ▶ ECE 220: Signals and Systems
 - ▶ ECE 280: Circuits
- ▶ Core courses in controls and communications:
 - ▶ ECE 421: Controls
 - ▶ ECE 460: Communications
- ▶ Electives:
 - ▶ ECE 410: DSP
 - ▶ ECE 450: Robotics
 - ▶ ECE 463: Digital Comms
 - ▶ ECE 464: Filter Design