M E 345 Professor John M. Cimbala Lecture 20

Today, we will:

- Reinforce the analogy between Fourier series and FFTs
- Review the pdf module: How to Analyze the Frequency Content of a Signal
- Do some example problems analyzing the frequency content of a signal

Example: Analyzing the frequency content of a signal using an FFT

Given: A voltage signal is sampled at sampling frequency $f_s = 160$ Hz. The resulting frequency spectrum is shown below:



We conclude that there is a frequency component of about 30 Hz, with an amplitude of about 4 volts. But how can we be sure? What if the 30 Hz peak is *aliased* from some higher frequency?

To do: What should we do to determine if this signal *really* has a frequency component at 30 Hz?

Solution:



Example: FFTs

Given: A voltage signal is sampled at two different sampling frequencies, 100 Hz and 160 Hz. The resulting frequency spectra are shown below:

• At $f_s = 100$ Hz, two spikes appear in the frequency spectrum, at 20 and 40 Hz.



• At $f_s = 160$ Hz, two spikes appear in the frequency spectrum, at 20 and 60 Hz. Amplitude



To do: Determine the frequencies most likely to actually be in the signal.Solution:

Example: FFTs

Given: A voltage signal is sampled at two different sampling frequencies, 300 Hz and 600 Hz. The resulting frequency spectra are shown below:

• At $f_s = 300$ Hz, a spike appears in the frequency spectrum at 120 Hz.



To do: Determine the frequency most likely to actually be in the signal. **Solution**: