# SDR - Spectrum Sensing

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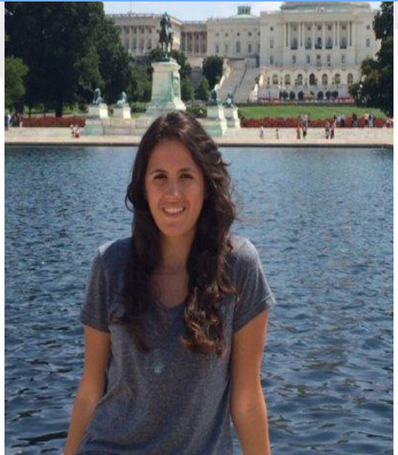


# Overview

- Digital Signal Processing (DSP)
- MATLAB Signal Processing
- SDR in ORBIT

# Digital Signal Processing

## Analog-to-Digital Conversion

- *Sampling:* measurement of analog signal at discrete time intervals
- *Quantization:* conversion of a continuous range of values into discrete values using a certain number of bits
- *Aliasing:* phenomenon in which a signal is reconstructed incorrectly due to sampling below nyquist frequency

- *Nyquist frequency:* twice the highest frequency of the continuous- time signal

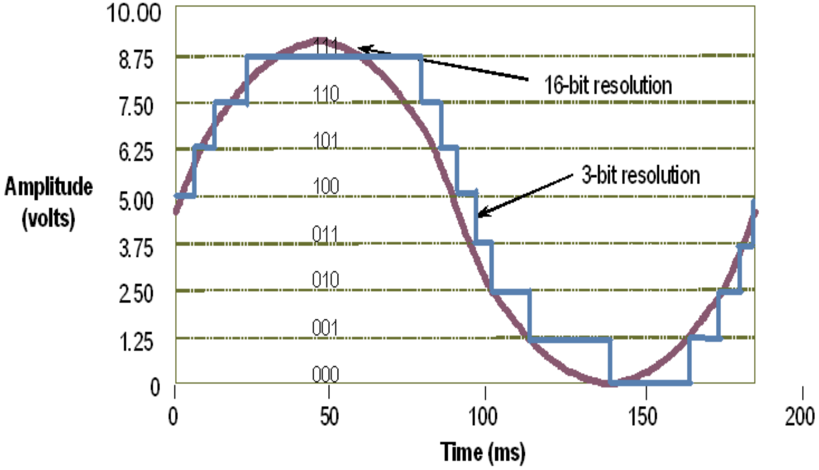


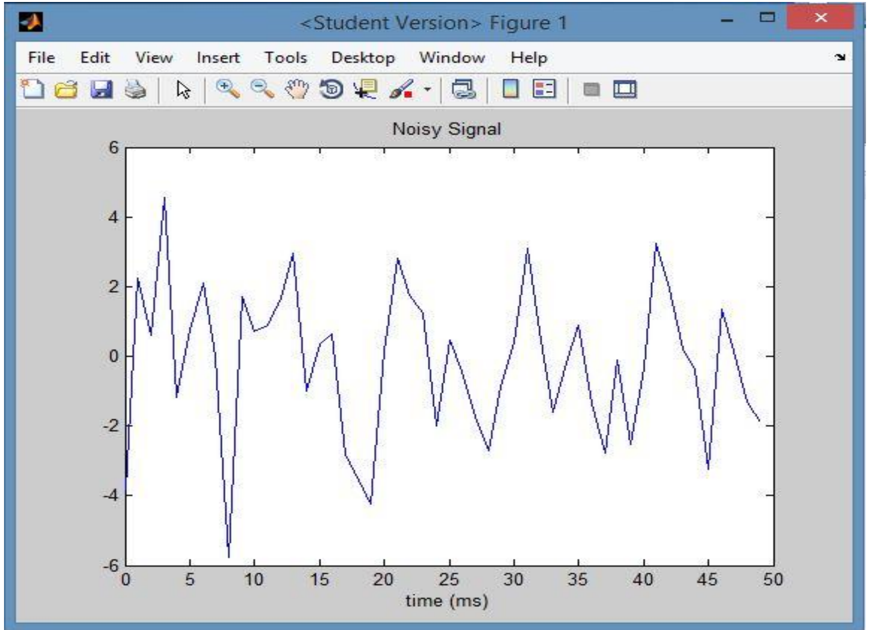
Photo: http://www.globalspec.com/ImageRepository/LearnMore/20142/9ee38d1a85d37fa23f86a14d3a9776ff67b0ec0f3b.gif

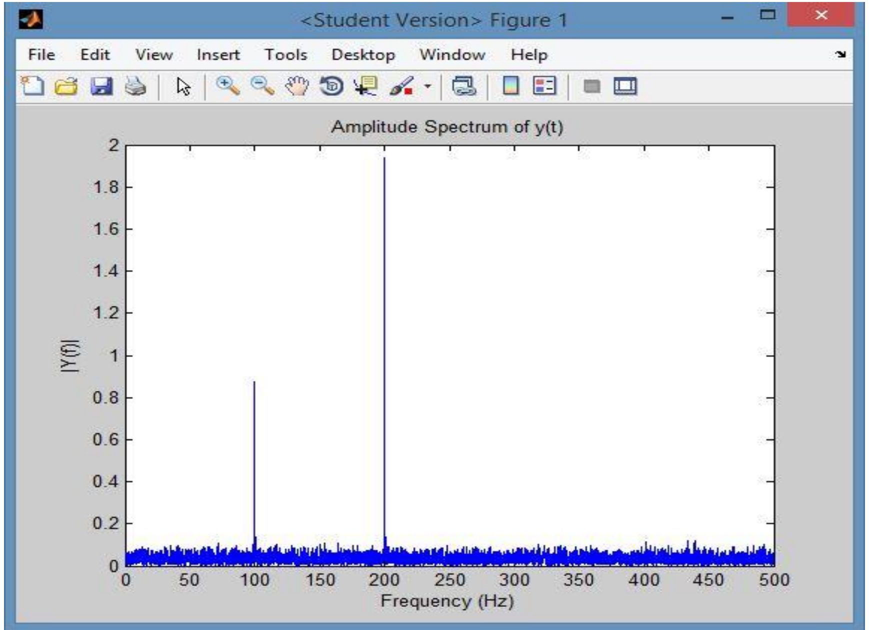
# MATLAB Signal Processing

## FFT (Fast Fourier Transform)

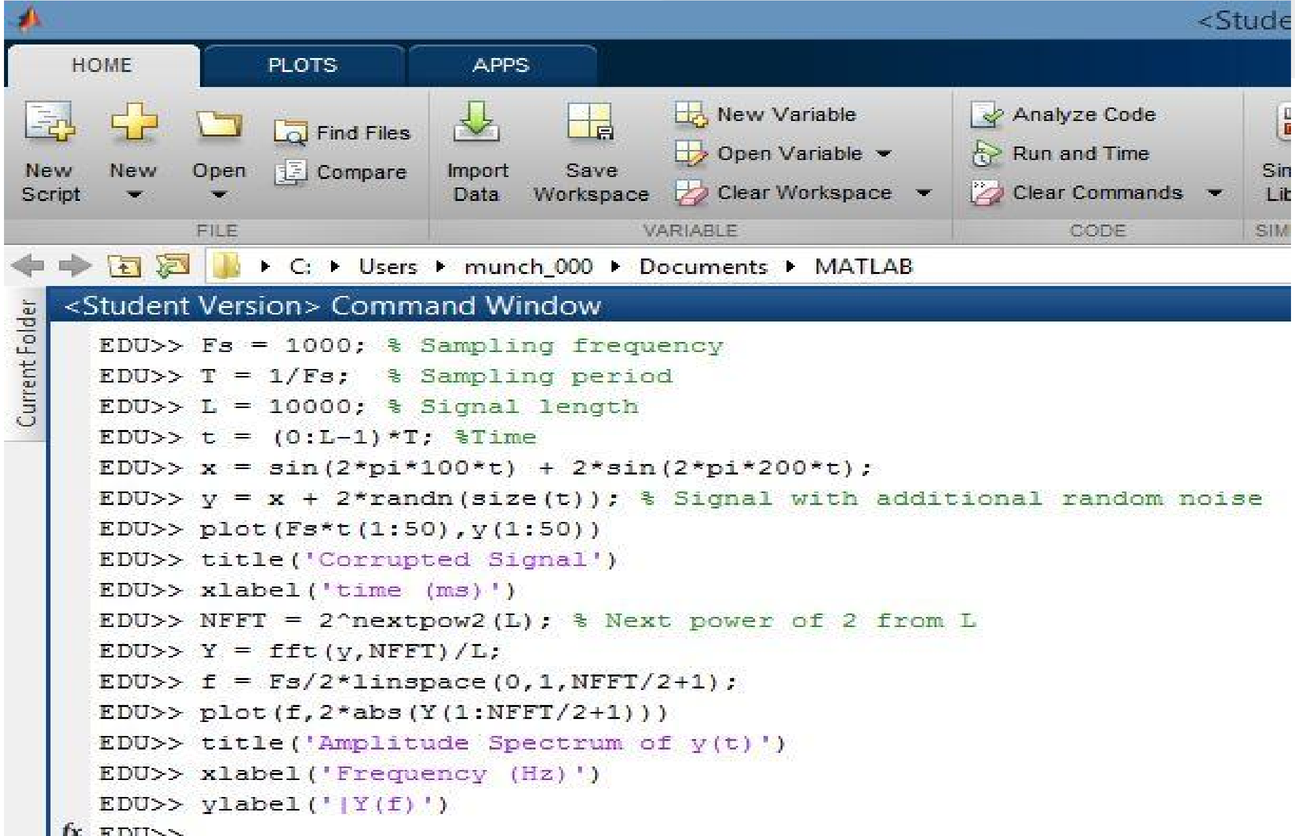
- Can be used in MATLAB to represent the signal in frequency domain

**Noisy Signal** **Frequency Domain**





# MATLAB Supporting Code

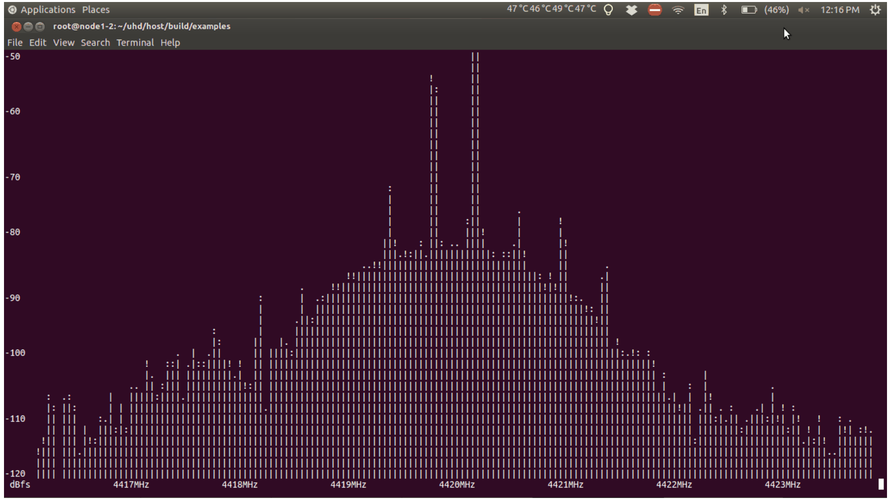


```
EDU>> Fs = 1000; % Sampling frequency
EDU>> T = 1/Fs;  % Sampling period
EDU>> L = 10000; % Signal length
EDU>> t = (0:L-1)*T; %Time
EDU>> x = sin(2*pi*100*t) + 2*sin(2*pi*200*t);
EDU>> y = x + 2*randn(size(t)); % Signal with additional random noise
EDU>> plot(Fs*t(1:50),y(1:50))
EDU>> title('Corrupted Signal')
EDU>> xlabel('time (ms)')
EDU>> NFFT = 2^nextpow2(L); % Next power of 2 from L
EDU>> Y = fft(y,NFFT)/L;
EDU>> f = Fs/2*linspace(0,1,NFFT/2+1);
EDU>> plot(f,2*abs(Y(1:NFFT/2+1)))
EDU>> title('Amplitude Spectrum of y(t)')
EDU>> xlabel('Frequency (Hz)')
EDU>> ylabel('|Y(f)')
fx EDU>>
```

# SDR in ORBIT

## USRP Tutorials

- Practiced sending and receiving signals with USRPs
- Used a USRP to transmit a signal at a specified frequency
- Received the signal with another USRP and plotted the frequency domain readings with ASCII characters



# Next Week

## Research

- Learn to use GNURadio Companion to build flow graphs
- Research filter designs for reducing noise

## Experiment

- Write our own tests for the USRPs (OEDL)
- Try to produce an approximate waveform based on receiver readings