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MUSI6202 Assignment 2

Generating a Sinusoid

First, we wrote a function which generates a sinusoid given input parameters of amplitude, sampling rate, frequency, length and phase. The plot of the first 5ms of a 400hz sine wave with a 44100Hz sampling frequency and a phase shift of half pi is shown below.

A screenshot of a cell phone

Description automatically generated

Generating a Square Wave

We then wrote a function generateSquare() that generates a square wave given input parameters of amplitude, sampling rate, frequency, length and phase. The plot of the first 5ms of a 400hz sine wave with a 44100Hz sampling frequency and a phase shift of zero is shown below. This has been overlaid over the plot of the previous section

A close up of a map

Description automatically generated

The sinusoid and the square wave approximation are pi/2 radians out of phase.

Fourier Transform

We wrote a function computeSpectrum() which outputs the phase and magnitude information of an input signal. The plots below show the magnitude and phase for both the sine wave from the first part and the square wave approximation generated in the second part.

A close up of a piece of paper

Description automatically generatedA screenshot of a cell phone

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The frequency resolution of this is spectrum is 4Hz as the signal is 0.5 seconds long with a sampling frequency of 44100Hz.

When the signal is zero padded to a length of 1 second, the frequency resolution becomes 1Hz.

Spectrogram

We wrote two functions generateBlocks() and mySpectrogram() which are used to compute the spectrogram of an input signal. It provides the option of either using a Hanning or a Rectangular window. These are shown below.

A screenshot of a cell phone

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The Hanning window provides a much better spectrogram as there is less spectral leakage. The spectrogram with the Hanning window has 10 distinct frequency components exactly where we expect them to be. When we use the rectangular window, not only are there these 10 frequency components, There are other frequency components appear in adjacent frequency bins. This is due to spectral leakage causing some frequencies to appear as others. A plot of the MATLAB spectrogram function output for this signal is shown below.

A close up of a logo

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