Signal Processing – Lab 2 – Spectrum Estimation

Student name: Paul Doherty

Student number: 10387129

Exercise 1: Generate Random Signal

A random signal was generated by using the function file ‘puzzle’ as required. This was done with the following MATLAB commands:

sn = 87129; %Random signal generated by last five digits of students number

nsamp = 8000; %number of samples in vector

v = puzzle(sn,nsamp) %generate random signal from puzzle function

A section of this signal was then plotted with the following MATLAB commands:

k=-4000:4000-1; %creates time vector

plot(k,v) %plots signal against time

xlabel('time (s)') %labels x-axis

ylabel('amplitude') %labels y-axis

xlim([-200 200]) %limits range of x-axis of figure plotted to screen

Below is a section of the random signal generated:



Exercise 2: Periodogram

The magnitude DFT of the random signal was found at different segment lengths and plotted with the amplitude shown on a decibel scale. These plots were then compared to the MATLAB function ‘periodogram’ which shows an estimate of the power spectral density of the entire signal. Below is the MATLAB code of how this was implemented:

N = 64; %set segment length

t=[-N/2:N/2-1]\*nsamp/N; %create time vector

v\_length = 1:N; %set segment length vector

V=fft(v(v\_length)); %finding DFT of v

V\_shift = fftshift(V); %find fftshift

V\_abs=abs(V\_shift); %find magnitude

subplot(2,1,1) %create subplot

plot(abs(t),(20\*log10(V\_abs/length(V)))) %plot magnitude of DFT on decibel

%scale

grid on %turn on grid for plot

xlim([0 nsamp/2]) %set limit of x-axis

xlabel('frequency') %label x-axis

ylabel('Power/frequency (dB/Hz)') %label y-axis

subplot(2,1,2) %create second subplot

periodogram(v,[],[],nsamp) %plot periodogram

Below is the plot comparison with the segment length (N) set to 64:



Below is the plot comparison with the segment length (N) set to 1024:



Below is the plot comparison with the segment length (N) set to 1024:



It can be seen from the plots above that as the segment length increases, the magnitude plot becomes increasingly similar to the ‘periodogram’ plot.