Digital SignalProcessing/Processamento Digital de Sinais

CETUC/PUC-Rio - Prof. Rodrigo de Lamare

Tutorial Questions/Lista de Exercícios - 3

1. Consider the discrete-time signal

a) Compute the DTFT of and write a Matlab routine to show its magnitude and phase.

b) Write a Matlab routine to compute the DFT of with N=16 points and show its magnitude and phase.

c) Explain the differences between items a) and b).

2. Consider 2 sequences of 4 samples, and , described by

a) Compute the DFT of 4 points of .

b) Compute the DFT of 4 points of

c) Compute the circular convolution of and , and show the results with Matlab.

d) Compute the linear convolution of and , multiplying the DFTs of and , and obtaining the inverse DFT. Show the operations with Matlab.

3. Compute the linear convolution of a signal with 5000 samples with a system/filter with impulse response with 60 samples of length using DFTs (or FFTs) with 128 ponits and the overlap-and-add method.

a) Sketch the filtering scheme with a block diagram, showing the how the input signal is split into block and the blocks overlap.

b) How many DFTs (or FFTs) are necessary to compute this linear convolution?

4. Consider an analogue signal that generates a sequence of 4096 samples in 1 second.

a) What is the highest frequency the ensures is samples without aliasing?

b) If a DFT of 4096 points is computed from the sampled signal, what is the spacing in Hz?

c) Suppose that one is interested only in the DFT corresponding to the frequency range between 200 and 300 Hz, how many multiplications are necessary to compute the DFT?

d) For the above example, how many multiplications would we need with an FFT algorithms using decimation in time?

5. Compute the z-transform for the sequence y(n) given by

where y(n) = 0 for n < 0. Supose that | and determine the region of convergence.

6. Consider an LTI system whose z-transform of the impulse response is given by

Suppose that the input of the system is a unit step.

a) Is the system stable? Explain.

b) Determine h[n] and the output y[n] of the system by computing the discrete convolution between x[n] and h[n].

c) Compute the output of the system using the inverse z-transform.