

Digital Filters & Spectral Analysis

Lecture 9

FFT

Problem sheet

1. A time domain signal, $x(t)=\cos(2\pi ft)$, where $f=4\text{Hz}$, is sampled at 16Hz for 0.25s . Draw the appropriate decimation in time (DIT) FFT flowgraph, showing all complex coefficients and use this to compute the DFT for this signal. Comment on the following:
 - a. Is there any smearing in the resulting spectrum? Explain your answer.
 - b. What is the complexity of your FFT?

2. Show that we can calculate the DFT $G[k]$ of a sequence $g[n]$ of length $2N$ using an N -point DFT and some additional computation. Use the following properties of the DFT/FFT to derive the solution:
- The FFT algorithm is designed to perform complex multiplications and additions
 - The DFT is a linear operation
 - Relevant properties of the DFT
 - The FFT follows a decimation and merge approach