ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
School of Computer and Communication Sciences

Handout 6 Signal Processing for Communications
Homework 4. Due: March 22, 2010

PROBLEM 1. Consider the two signals $x[n]$ and $y[n]$ defined as follows:

$$x[n] = \begin{cases} \sin(\frac{n\pi}{5}) & 0 \leq n \leq 9 \\ 0 & \text{otherwise} \end{cases}$$

$$y[n] = \begin{cases} n & 0 \leq n \leq 9 \\ 0 & \text{otherwise} \end{cases}$$

Use MATLAB to:

1. Plot $z[n] = x[n] + y[n]$.
2. Compute and plot $z[n] = x[n] \star y[n]$.
3. Compute the energy of $x[n]$.
4. Using the MATLAB function **fft**, verify Parseval's identity between $x[n]$ and its DFT.

PROBLEM 2. Write a Matlab function that takes as input a sequence $x[n]$ of length N, returns the DFT of $x[n]$, and plots both $x[n]$ and its DFT (magnitude and phase).

1. Try your function for the input signal $x[n] = \delta[n-3]$.
2. Use Matlab's **fft** function to verify your answer to part (1).

PROBLEM 3.

1. Write a Matlab function that takes as input N and plots the following signal for $N = 5, 8$.

$$x_N[n] = \begin{cases} 1 & 0 \leq n \leq N-1 \\ 0 & \text{otherwise} \end{cases}$$

2. Derive analytically the $2N$ point DFT of the above defined step function for an arbitary N and plot it for $N = 5, 8$.
3. Modify the DFT function you wrote for problem 2 to compute and plot (both the phases and the magnitudes of) the $2N$ point DFT of $x_N(n)$ for $N = 5, 8$.
4. Use the Matlab function **subplot** to display your answer to parts (2) and (3) in one window.