DIGITAL TRANSMISSION — MARCH 25, 2015

HW1 — DUE APRIL 9, 2015

PROBLEM 1 (10p)

In a companion file you find a signal of 1000 samples. Determine its PSD by using: a) Correlogram, b) Periodogram, c) Welch, and d) AR model. For each method report all parameters. On the same figure plot the various estimates using a different color. Freq. scale $0 \div 1$, amplitude scale in dB with a dynamic of 50dB.

PROBLEM 2 (10p)

By using a suitable FIR filter split the signal into two signals, one with 'continuous PSD' and one with 'spectral lines'.
For the 'continuous PSD' signal determine a suitable AR model.
Report $A(z)$ and σ_w^2. Plot zeros of $A(z)$ in the z-plane.
Plot the PSD. Use same scales as above.
Plot the frequency response (in dB) of used FIR filter.

PROBLEM 3 (10p)

For the signal with 'spectral lines', determine a suitable AR model. Report $A(z)$ and σ_w^2. Plot zeros of $A(z)$ in the z-plane.
Plot the PSD. Use same scales as above.

PROBLEM 4 (10p)

Determine Amplitude, Frequency and Phase of each 'spectral-line' of signal at Problem 3. Use an optimum method, although complex from a computational point of view.
Note that determining the frequency by the peaks of the DFT of the signal may not be very accurate if the number of samples is small.

PROBLEM 5 (10p)

Consider the signal with 'continuous PSD' at Problem 2. For the optimum predictor, determine the convergence curve of the LMS algorithm. Plot $|f_N(n)|^2$, in dB, vs. n, for $n \in \{0, \cdots, 400\}$. Plot also $\mathrm{Re}[C_i(n)]$ and $\mathrm{Im}[C_i(n)]$ vs. n (on same figure), for $i = 1, 2, \cdots, N$. At instant $n = 350$ what is the value of coefficients and the avg of $|f_N(n)|^2$ over the window $[350-10, 350+10]$? The value should be in dB.

PROBLEM 6 (10p)

Repeat above problem using the RLS algorithm.