Signals & Systems

Laboratory no. 10 – Nonparametric Identification

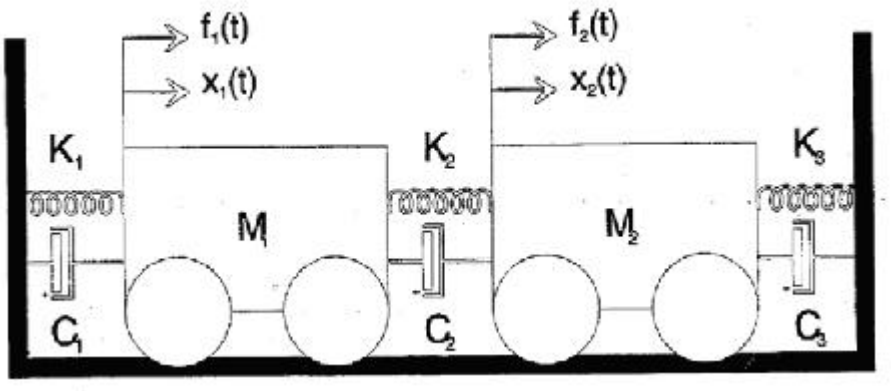
Hint

In the present version of the Signal Processing Toolbox there are available functions that calculate the following estimators of nonparametric models in the frequency domain:

- power spectral density:
  - **[Pxx,f] = psd(xn,nfft,Fs,window,noverlap,dflag);**
  - **[Pxx,f] = pwelch(xn,window,noverlap,nfft,Fs);**
- cross-power spectral density:
  - **[Pxx,f] = csd(xn,yn,nfft,Fs,window,noverlap,dflag)**
  - **[Pxx,f] = cpsd(xn,yn,window,noverlap,nfft,Fs);**
- frequency response function:
  - **[Pxx,f] = tfe(xn,yn,nfft,Fs,window,noverlap,dflag)**
  - **[Pxx,f] = tfestimate(xn,yn,window,noverlap,nfft,Fs);**
- coherence function:
  - **[Pxx,f] = cohere(xn,yn,nfft,Fs,window,noverlap,dflag)**
  - **[Pxx,f] = mscohere(xn,yn,window,noverlap,nfft,Fs);**

Exercise 1.

Model in Simulink the system from the figure below and simulate it by forcing it with random noise. Time histories of input (force f_1) and outputs (displacements x_1 and x_2 and corresponding velocities and accelerations) save to the Matlab workspace. Set the appropriate length of the simulation



Data: $M_1 = 10$, $M_2 = 7$, $C_1 = 0.7$, $C_2 = 0.9$, $C_3 = 0.7$, $K_1 = 120$, $K_2 = 200$, $K_3 = 170$

Exercise 2.

For the stored data estimate the power spectral densities, frequency response functions and coherence functions. To give the statistical meaning to the estimators, one needs to use the time histories with appropriate length (averaging). All the estimators should be specified for the input signal and outputs in form of displacements, velocities and accelerations.

Exercise 3.

Compare graphically estimators obtained in Exercise 2. Comment on the results.

Exercise 4.

Repeat Exercises 2 and 3 adding earlier the 0.1 and 0.2 noise to the output data.