EEL 6504

Homework # 4

Due April 14, 2022

This problem can be called frequency doubling, because we want to learn the mapping that doubles the frequency of a single sinewave with an adaptive filter. Take the input at 1KHz sampled at 10KHz, and the desired response at 2KHz, and generate 2 seconds of data.

1. Use a linear FIR filter of size 10 trained with Wiener solution and LMS. Verify that the Wiener filter fails (as it should). Explain why in your own words.

2. Apply the KLMS to this problem (also using a embedding vector of 10 samples) and show that the solution is very reasonable. Experiment with different kernel sizes and also stepsizes. With the same parameters (i.e. no adaptation), change the input frequency in the range between 500 Hz and 2KHz and show experimentally the generalization of the trained model.

3. Now repeat 2 with noise. Create a r.v. u obtained from a Gaussian mixture $p(u) = 0.9G(0,0.1) + 0.1G(4,0.1)$ and add the noise to the desired response. Quantify the effect of the noise in the model trained with MSE. Now implement the minimum error entropy (MEE) and compare the performance with the MSE. You have to properly determine the kernel size in MEE for optimal results. So, show the effect of the kernel size in performance as a function the kernel size in the MEE cost. You should also experiment for generalization as in 2.