Bangladesh University of Engineering and Technology

Department of Electrical and Electronic Engineering (EEE)

Experiment No: 2 (Part C)

Assignment: Correlation

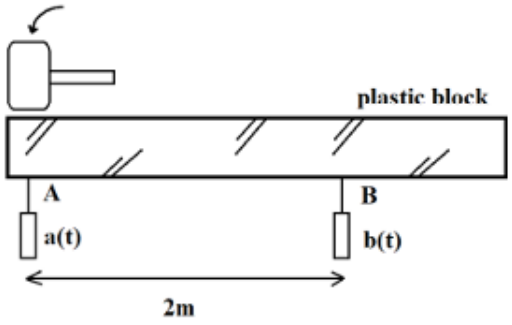
Instructions: Include your Matlab code snippets and all necessary command window output+plots in your report.

1. Write a code segment that will perform cross-correlation between two discrete signals using only the `conv()` function.

2. The figure below depicts a plastic block that has been hit by a hammer on its left side. Two piezoelectric sensors (with some additional circuits) have been placed on points 'A' and 'B'. The vibration caused by the hit enabled the sensors to be faced with the following two signals at those two points:

$$a(t) = 4e^{-6t}\sin(400t)\,u(t)$$

$$b(t) = 2e^{-6t}\sin\left(400t - \frac{\pi}{10}\right)(1 - e^{-1000t})\,u(t)$$



If the sensors are designed to have a sampling frequency of $\mathbf{10kHz}$, estimate the sound velocity created by the vibration in that plastic medium.

3. Use the `audioread()` function to read a voice clip of yourself (or somebody you know) in an .mp3 or a .wav format. `audioread()` returns a signal and a sampling frequency:

```
[y,Fs] = audioread("sample.mp3");
```

Considering the principles of **correlation**, write a MATLAB code to estimate the voice pitch (fundamental frequency of that voice) from the voice clip signal.

4. A clean Radar-signal is being sent around a transmission-tower (TX). A bird happened to get into its range. One of the Radar signals hit the bird and came back to the TX-tower. The retrieved (RX) signal, however, was not as clean as the transmitted one. It was very cold $(-40°C)$ that day making environmental sound velocity $305\ m/s$.

(a) Plot/Stem both TX and RX signals on the time span mentioned.
(b) Zoom into the non-zero part of the TX signal.
(c) How far away was the bird from the tower?
(d) Determine the noise power within the RX signal in dB.

5. Complete the following tasks from the lab-sheet:

(i) Estimation of impulse response
(ii) Signal smoothing by a moving average (MA) system
(iii) Detection of a transmitted sequence

Comment on how you can estimate the response in (i) and smoothen the signal in (ii) better.