Lab 5: Study on Cross correlation, Autocorrelation and Impulse Response

Objectives:

To understand the cross correlation & autocorrelation of signals, impulse response of a system by applying a discrete signal

Theory for correlation:

Correlation is an operation used in many applications in digital signal processing. It is a measure of degree to which two sequences are similar. Given two real-valued sequences $x(n)$ and $y(n)$ of finite energy, the *cross correlation* of $x(n)$ and $y(n)$ is a sequence $r_{xy}(l)$ is defined by

$$r_{xy}(l)=\sum_{n=-\infty}^{\infty}x(n+l)y(n) \qquad r_{xy}(l)=\sum_{n=-\infty}^{\infty}x(n)y(n-l)$$

The index l is called the *shift or lag parameter*.

Similarly, $$r_{yx}(l)=\sum_{n=-\infty}^{\infty}y(n+l)x(n) \qquad r_{yx}(l)=\sum_{n=-\infty}^{\infty}y(n)x(n-l)$$

Hence $$r_{xy}(l)=r_{yx}(-l)$$

Labwork:

1. Perform the crosscorrelation of the following 2 sequences using *xcorr (x,y)* function:

$$x(n)=\{\underset{\uparrow}{1},\ 2,\ 4\} \quad \text{and} \quad y(n)=\{\underset{\uparrow}{1},\ 1,\ 1,\ 1\}$$

2. Perform the autocorrelation of the following signal using *xcorr (x)* function:

$$x(n)=\{\underset{\uparrow}{1},\ 2,\ 1,\ 1\}$$

3. Consider a discrete signal $x(n) = u(n) – u(n–10)$ be an input to an LTI system with impulse response $h(n) = (0.9)^n u(n)$. Determine the output signal $y(n)$ using *conv(x,h)*. Also plot $x(n)$, $h(n)$ and $y(n)$ using MATLAB.

Lab Assignment-5: Develop a MATLAB function to perform the median and moving average of a sequence.