Experiment 2

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BE Comps B(2

Aim: Discrete Auto / Cross correlation between two signals.

Theory: Correlation is a statistical operation that measures the degree to which two signals are similar

- Auto correlation - This is a measure of how a signal correlates with itself over time.

The formula is given by

$$R_{xx}(m) = \sum_{n=-\infty}^{\infty} x(n) \cdot x(n-m)$$

where, $x(n)$ is the discrete signal and m is the time lag.

Cross correlation.

It measures the similarity between two different signals as a function of the time-lag applied to one of them.

The formula is given by

$$R_{xy}(m) = \sum_{n=\infty}^{\infty} x(n) \cdot y(n-m)$$

where $x(n)$ and $y(n)$ are the two signals being compared.

Conclusion - In this experiment, we implemented disc
auto and cross correlation between two signals to
study their similarities and alignment properties.
we observed, through auto correlation we can
identify periodic pattern and through cross
correlation we can get insights into the degree
of alignment and possible phase shifts of the
signal.

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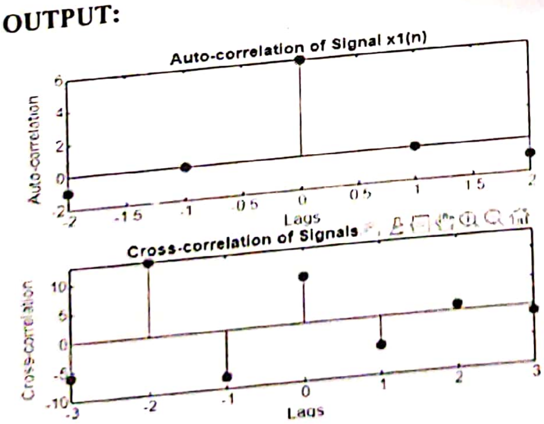
DIGITAL SIGNAL PROCESSING (DSP) EXPERIMENT 02

CODE:

```
% Define the original signal x(n) for auto-correlation x1 = [-1 2 1]; % signal
x1(n)

% Compute the auto-correlation of the signal x1 [auto_corr_x1, lags_x1] =
xcorr(x1);

% Define the original signals x(n) and y(n) for cross-correlation x2 = [-3 2 -1 1]; % signal
x2(n)
y = [-1 0 -3 2]; % signal y(n)

% Compute the cross-correlation of the signals x2 and y [cross_corr_xy, lags_xy] =
xcorr(x2, y);

% Create a figure to show both auto-correlation and cross-correlation figure;

% Plot the auto-correlation of x1
subplot(2,1,1);
stem(lags_x1, auto_corr_x1, 'filled'); title('Auto-
correlation of Signal x1(n)'); xlabel('Lags');
ylabel('Auto-correlation'); grid on;

% Plot the cross-correlation of x2 and y subplot(2,1,2);
stem(lags_xy, cross_corr_xy, 'filled');
title('Cross-correlation of Signals x2(n) and y(n)'); xlabel('Lags');
ylabel('Cross-correlation'); grid on;
```

OUTPUT:



```
% Take input for the compression factor a
a = input('Enter the compression factor a: ');

% Compute the compressed signal x(a*n) compressed_n =
n * a;
compressed_x = interp1(n, x, compressed_n, 'linear', 0);

% If any value in compressed_n exceeds the maximum n, set corresponding x to 0 compressed_x(compressed_n > max(n))
= 0;

% Create a figure to show all three signals figure;

% Plot the original signal subplot(3,1,1);
stem(n, x, 'filled'); title('Original Signal x(n)');
xlabel('n');
ylabel('x(n)'); grid on;

% Plot the expanded signal subplot(3,1,2);
stem(expanded_n, expanded_x, 'filled');
title(['Expanded Signal x(n / b) with b = ', num2str(b)]); xlabel('n');
ylabel('x(n / b)'); grid on;

% Plot the compressed signal subplot(3,1,3);
stem(compressed_n, compressed_x, 'filled');
title(['Compressed Signal x(a \times n) with a = ', num2str(a)]); xlabel('n');
ylabel('x(a \times n)'); grid on;
```

OUTPUT: