Experiment No: 04

Experiment Name: Identification of Signal Delays and Periodicity using correlation.

Theory:

In DSP, the process of figuring out the time delay between two or more signals is known as signal delay identification. It entails determining how much one signal is displaced or delayed in relation to another signal.
In many different applications, including time synchronization, audio and video processing, communications, radar systems, and more, determining signal delays is essential.
Periodicity is the ability of a signal to recur after a predetermined amount of time, or period. Determining a signal's periodicity is crucial for a number of analysis and processing jobs in digital signal processing (DSP).

Code:
Identifying Delays:

```
1. clc
2. clear all
3. close all
4. fs=1000
5. t = 0:0.001:1;
6. frequency = 10;
7. dutyCycle = 50;
8. delay = 0.15;
9.
10. signal = square(2*pi*frequency*t, dutyCycle);
11. subplot(3,1,1)
12. plot(signal)
13. title('Given Square Wave')
14. signalWithDelay = [zeros(1, round(delay*fs)), signal(1:end-round(delay*fs))];
15. subplot(3,1,2)
16. title('Delayed Version of the Square Wave')
17. plot(signalWithDelay)
18. [correlation, lag] = xcorr(signal, signalWithDelay);
19. subplot(3,1,3)
20. plot(lag, correlation)
21. title('Auto Correlation')
```

Periodicity:

```
1. clc
```

```
clear all
close all

fs = 1000;
t = 0:1/fs:1;
f = 10;
x = sin(2*pi*f*t);

shift_amount = 0.25;
shifted_x = [zeros(1, round(shift_amount*fs)), x(1:end-round(shift_amount*fs))];
autocorr_x = xcorr(x);
autocorr_shifted_x = xcorr(shifted_x);

lags = -length(x)+1:length(x)-1;
figure;
subplot(4, 1, 1);
plot(x);
title('Main Signal');
subplot(4, 1, 2);
plot(shifted_x);
title('Shifted Signal');
subplot(4, 1, 3);
plot(lags, autocorr_x);
title('Autocorrelation of Original Signal');
28. subplot(4, 1, 4);
plot(lags, autocorr_shifted_x);
title('Autocorrelation of Time-Shifted Signal');
if autocorr_x(length(x)+1) > 0.9 * max(autocorr_x)
disp('Signal exhibits periodicity with a time-shifted version.');
else
disp('Signal does not exhibit clear periodicity with a time-shifted version.');
End
```

Output:

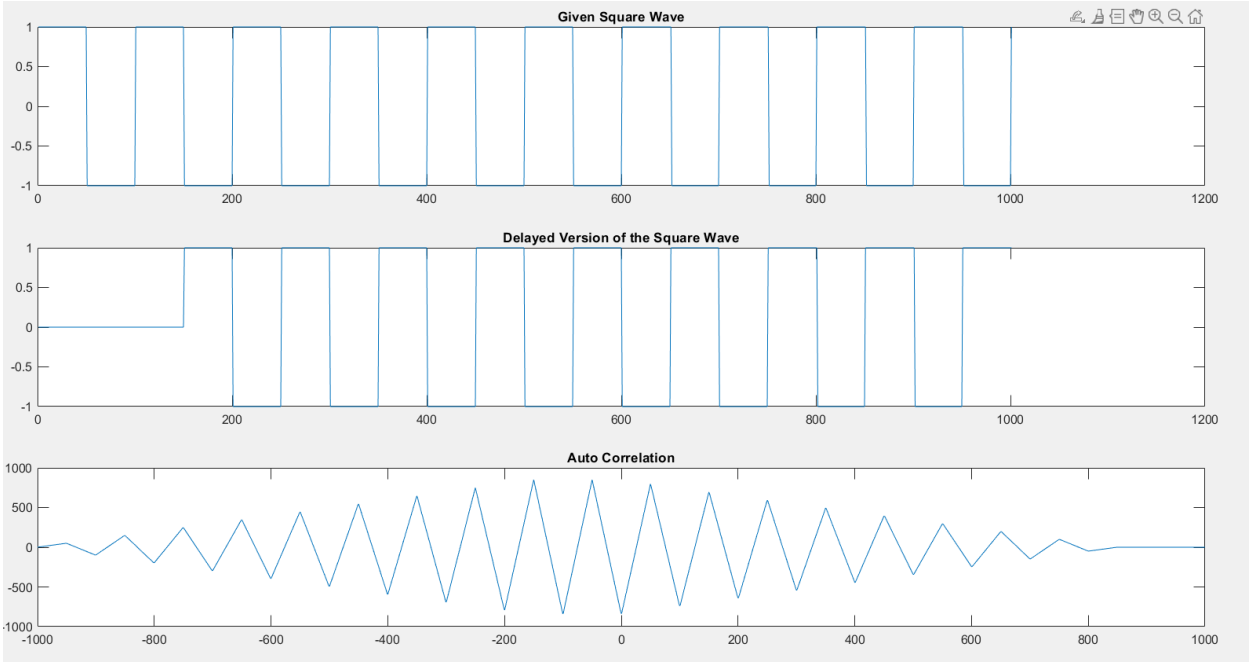

Fig: Identifying delays

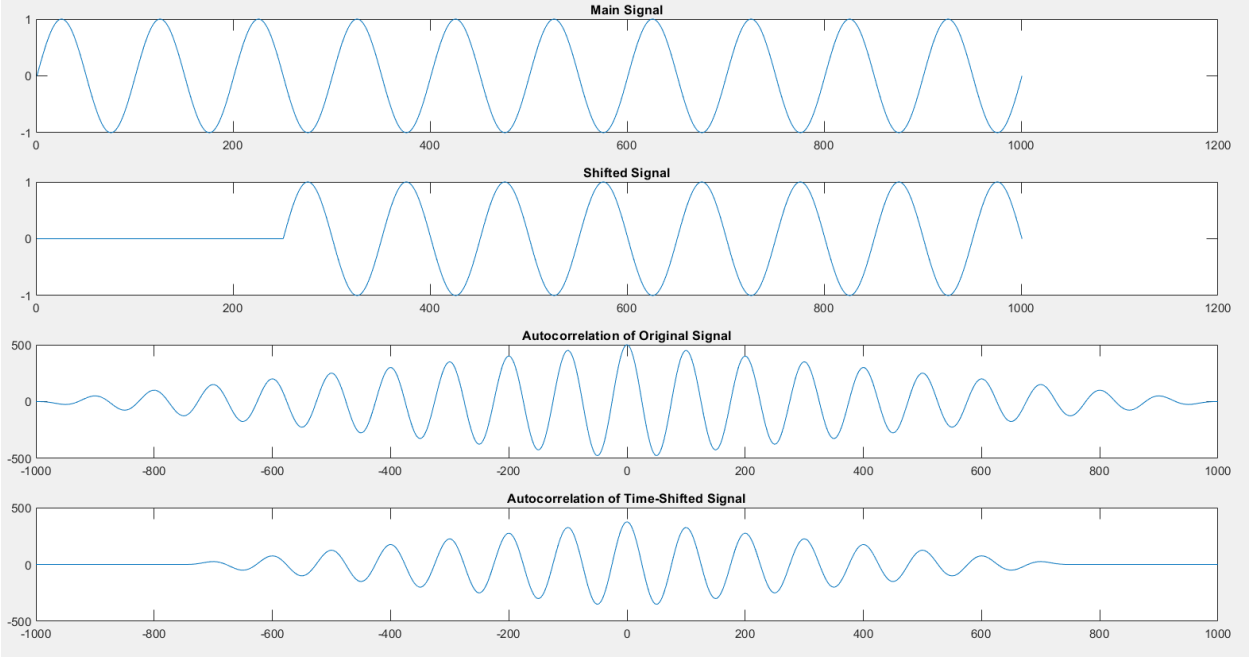

Fig: Periodicity

Discussion:

In this experiment, we learnt how to identify periodicity and delays. We used autocorrelation method for this system.