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RADAR Application using Cross Correlation in MATLAB

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Table of Contents

Introduction

In this project, an application of cross correlation is applied which is used to examine or identify an aircraft within a specific range through RADAR. The implementation has been done on a tool known as MATLAB.

Working

The steps taken are following:

- First, a waveform has been introduced which is going to strike on the aircraft that is on a height of 15.24 km which the average height on which fighter jet flies.
- The waveform is then shifted according to the time taken for the RADAR signal to be transmitted and received back i.e., 101.6 µs which travels according to the speed of light.
- Since, the signal is travelling in atmosphere so there must be noise signal occurring in the travel, for that a noise has been added to the delayed signal.
- Finally, cross-correlation is performed between the original signal, and this modified signal to check the similarities between these two.

Code

```
t = 0:100
x = cos(2*pi*0.1*t)              % Original Signal
y = cos(2*pi*0.1*t-101.6e-6)     % Time-Shifting (Delayed)
z = y + rand(1,101)              % Noise Insertion

r = xcorr(x,z)
```

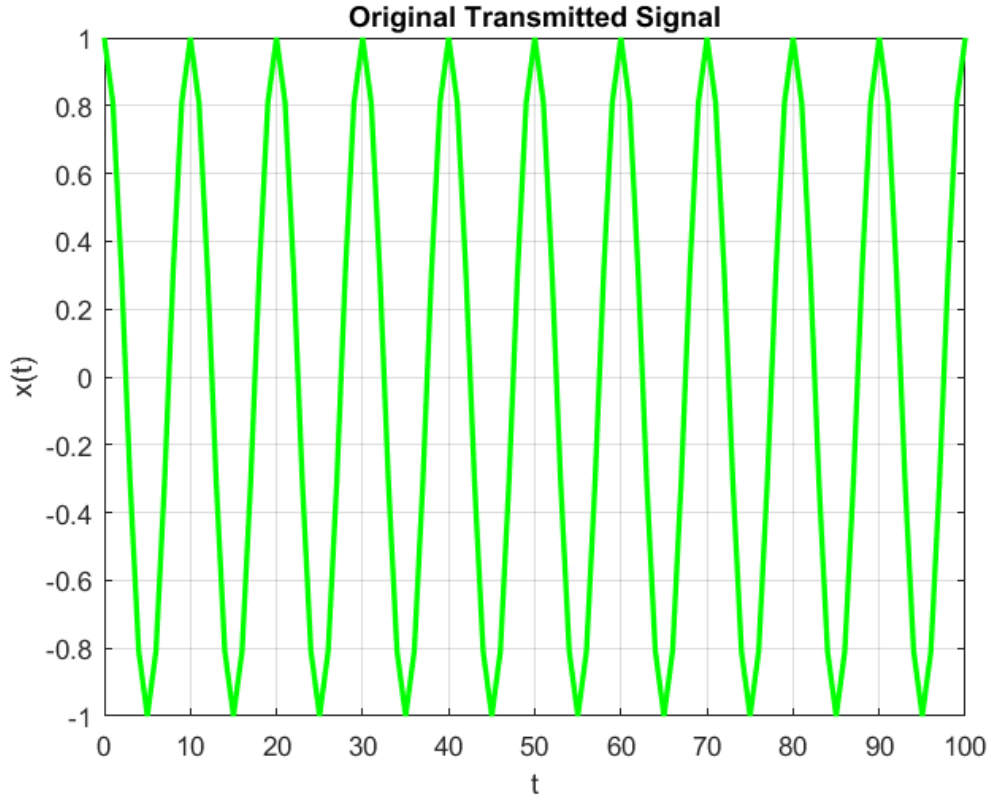
```
plot(t,x,'g','Linewidth',2)
title('Original Transmitted Signal')
xlabel('t')
ylabel('x(t)')
grid
figure
```

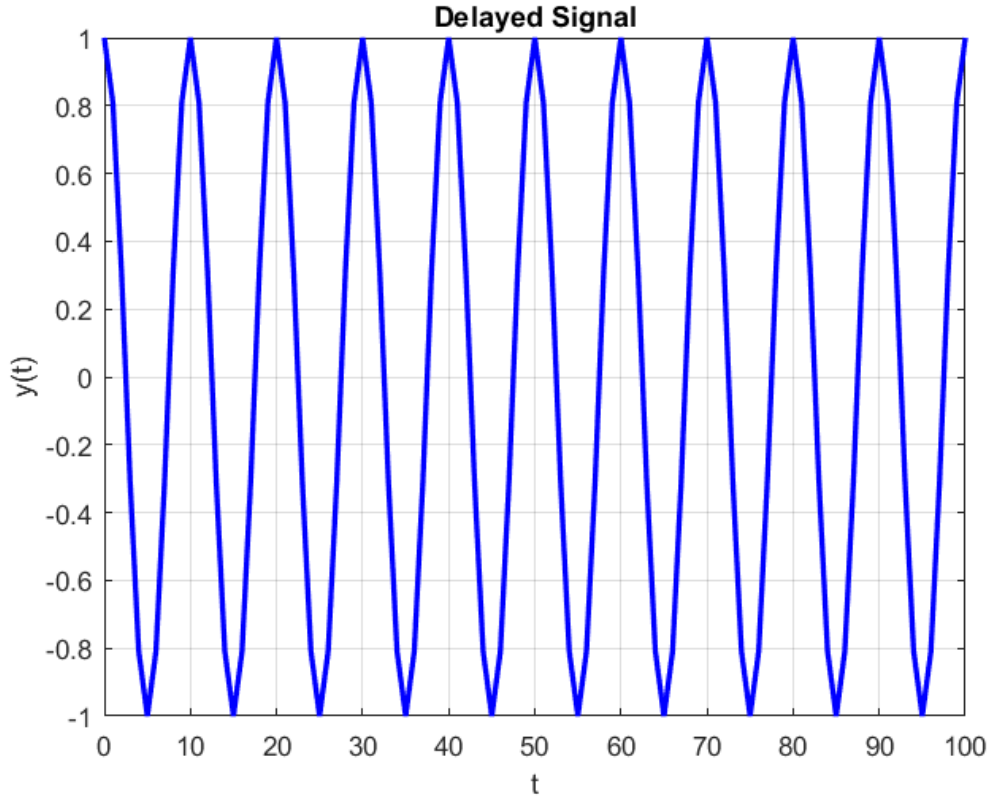
```
plot(t,y,'b','Linewidth',2)
title('Delayed Signal')
xlabel('t')
ylabel('y(t)')
grid
figure
```

```
plot(t,z,'r','Linewidth',2)
title('Corrupted Recieved Signal')
xlabel('t')
ylabel('z(t)')
grid
figure
```

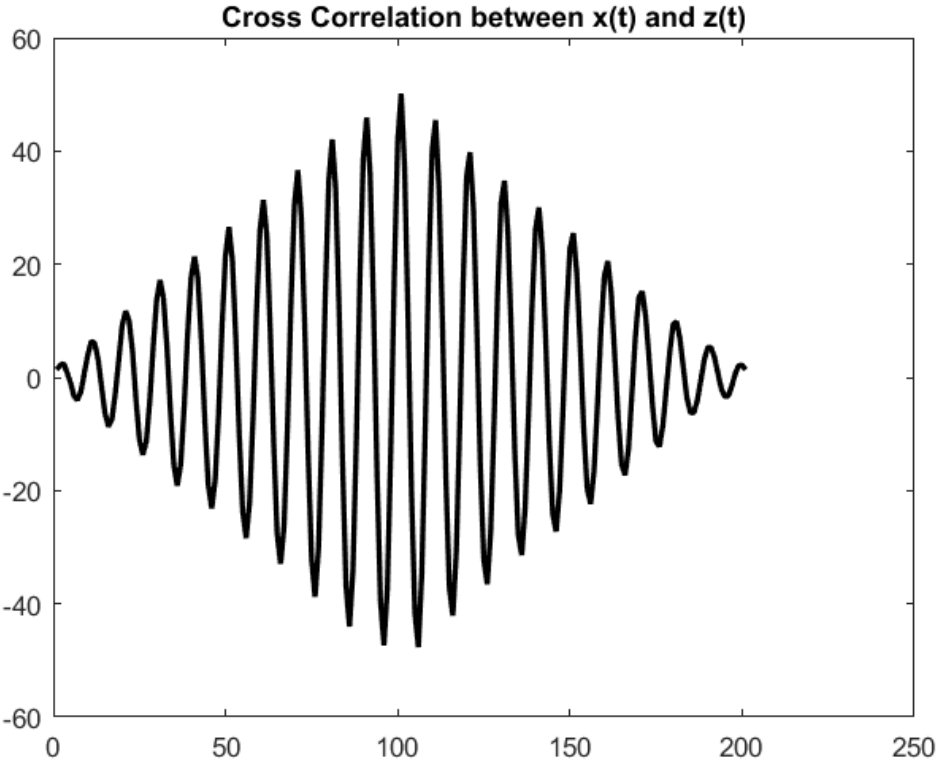
```
plot(r,'k','Linewidth',2)
title('Cross Correlation between x(t) and z(t)')
```

Output


Original Transmitted Signal
x(t)
t
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
10
20
30
40
50
60
70
80
90
100


Delayed Signal
y(t)
t
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
10
20
30
40
50
60
70
80
90
100


Corrupted Recieved Signal
z(t)
t
2
1.5
1
0.5
0
-0.5
-1
0
10
20
30
40
50
60
70
80
90
100


Cross Correlation between x(t) and z(t)
60
40
20
0
-20
-40
-60
0
50
100
150
200
250

Result

From the above implementation, two results will be achieved i.e., either similarities would be found, or it will not. So, the outcomes would be:

- If similarities are found, then the transmitted signal and the received signal is same which means an aircraft has been detected in the specified range.
- If similarities are not found, then the transmitted signal and the received signal is not same which means nothing has been detected in the specified range.

Conclusion

It is concluded that, the cosine waveform which is transmitted and the corrupted signal which is received are same because huge similarities have been found describing a single outcome that an aircraft has been detected within the airspace.