Rajshahi University of Engineering & Technology

Lab Report on
Industrial Electronics Sessional
ECE 3206

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Experiment No: 05

Experiment Name: Experimental Study of Practical Application of Causal, Non-causal and Anti causal Signals

Theory:

Signal processing and analysis encompass the intriguing concepts of causal, non-causal, and anticausal signals, each with distinct implications for understanding signal behavior. Causal signals exhibit a logical sequence, where the present and future values solely rely on past values, mirroring cause-and-effect relationships. This fundamental concept finds applications in numerous real-world systems, such as natural processes and dynamic systems.

In contrast, non-causal signals defy traditional causality by incorporating dependencies on both past and future values. Although less intuitive, they hold significance in specialized mathematical contexts and abstract signal manipulations. Anticausal signals, a reverse of causality, intrigue theorists as they project future values based on present and past occurrences. While challenging to encounter physically, they contribute to theoretical frameworks and certain mathematical formulations.

This classification holds pivotal importance in signal processing. Causal signals enable modeling and analysis of real-world systems, while non-causal and anticausal signals, though rarer in practical applications, underpin mathematical abstractions and theoretical explorations. This understanding is pivotal for devising effective signal processing techniques, designing algorithms, and enhancing our comprehension of signal behavior across diverse domains. As such, the differentiation between causal, non-causal, and anticausal signals enriches our insights into the intricate world of signal dynamics.

Software Used: MATLAB

Code:

Code for Causal Signal:

```
clear all
clc

x=[1 2 3]
len=length(x)

X=0;
z=sym('z');
for i=0:len-1
    X=X+x(i+1).*z^(-i);
end

disp('z transform');
disp(X);


t=-10:1:10;
p=100*(t<0)+100*(t>0)

plot(t,p);
```

Code for Anti-Causal Signal:

```
clear all
clc

x=[1 2 3]
len=length(x)

X=0;
z=sym('z');
for i=0:len-1
    X=X+x(i+1).*z^(i);
end

disp('z transform');
disp(X);

t=-10:1:10;
p=100*(t<10)+100*(t<10);

plot(t,p);
```

Code for Non-Causal Signal:

```
clear all
clc
x=[1 2 3 4 5]
%x=input('Enter signal: ')

len=length(x)
index=input('Enter zeroth
index: ')
X=0;
z=sym('z');

for i=0:len-index
    X=X+x(index+i).*z^(-i);
end
%disp(X);
for i=1:index-1
    X=X+x(i).*z^(index-i);
end

disp('z transform');
disp(X);

t=-15:1:15;
p=15*(t<0)+15*(t>0&t<15)

plot(t,p);



%z=-5:5;
%plot(z,X);
```

Output:

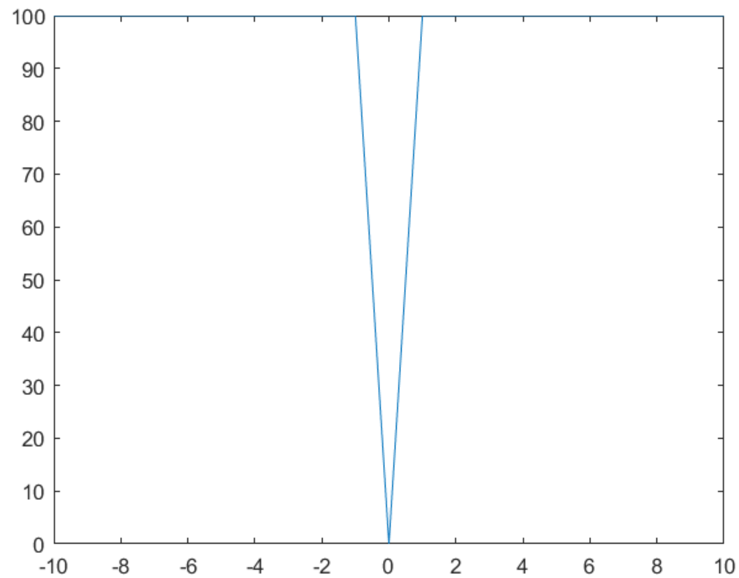

Fig. 1: Output for Causal Signal

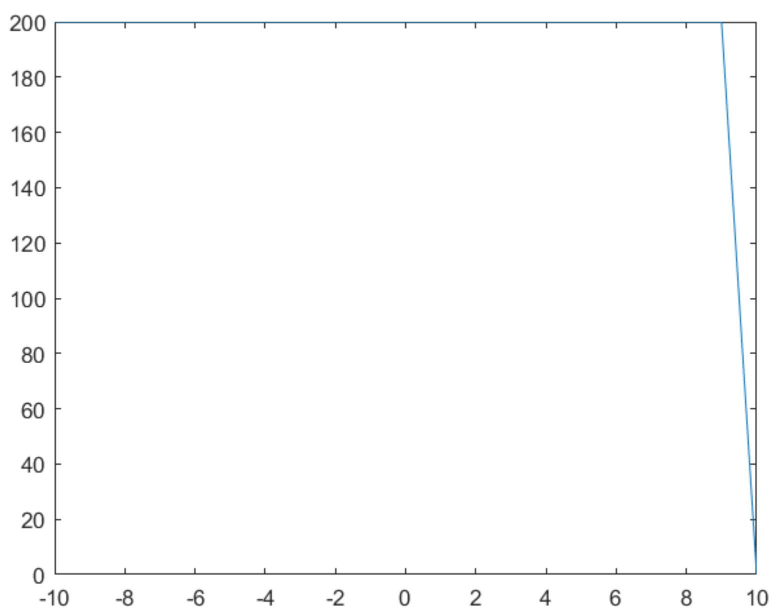

Fig. 2: Output for Anti-Causal Signal

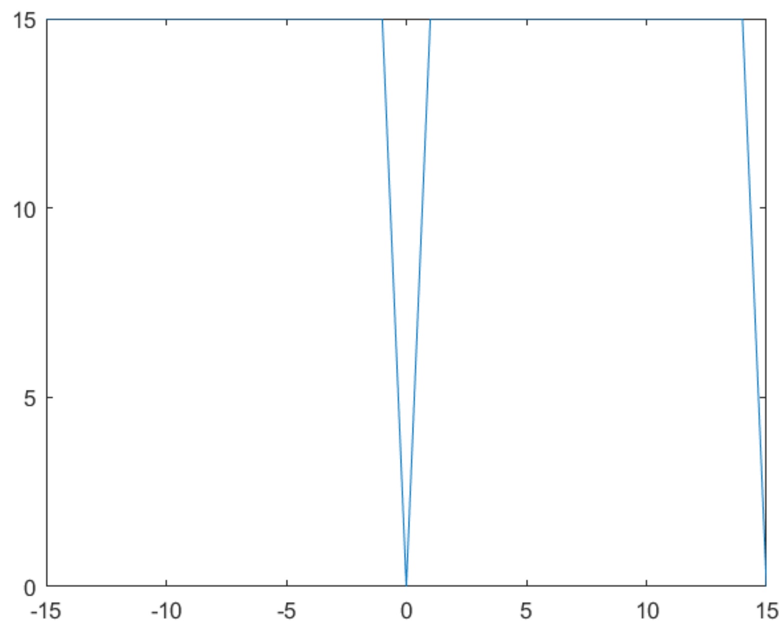

Fig. 3: Output for Non-Causal Signal

Discussion & Conclusion:

The provided code segments illustrate the characteristics of Causal, Anti-Causal, and Non-Causal signals. The Causal Signal code employs the z-transform to analyze a signal's behavior in the context of the past. A step function illustrates this, with a value of 100 for positive time instances. Conversely, the Anti-Causal Signal code explores signals dependent on future values. The z-transform displays this behavior, with a step function indicating 100 for positive time instances. The Non-Causal Signal code examines a signal influenced by both past and future values. The z-transform demonstrates this, presenting a step function with a value of 15 for positive time instances. These experiments accentuate the importance of signal time-dependency, aiding in the comprehension and utilization of these signal types in various applications.