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Laboratory 1: Signal Processing with MATLAB

Part 1:Experimental equipment and devices

MATLAB

Part 2:Experimental content

1. Use MATLAB to draw the picture to verify the period and general period of the signal compared with theoretical analysis.

2. Use MATLAB to verify Fourier Series by graph and the change of N and K

Part 3:Experimental procedure and results

Task 1

Produce:

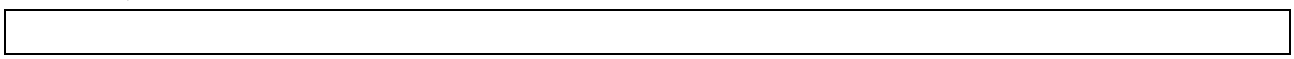
```
//
n = 0:1:20;
x = cos(pi * n / 6);
stem(n, x);
x = cos(2 * n);
stem(n, x);
//
```

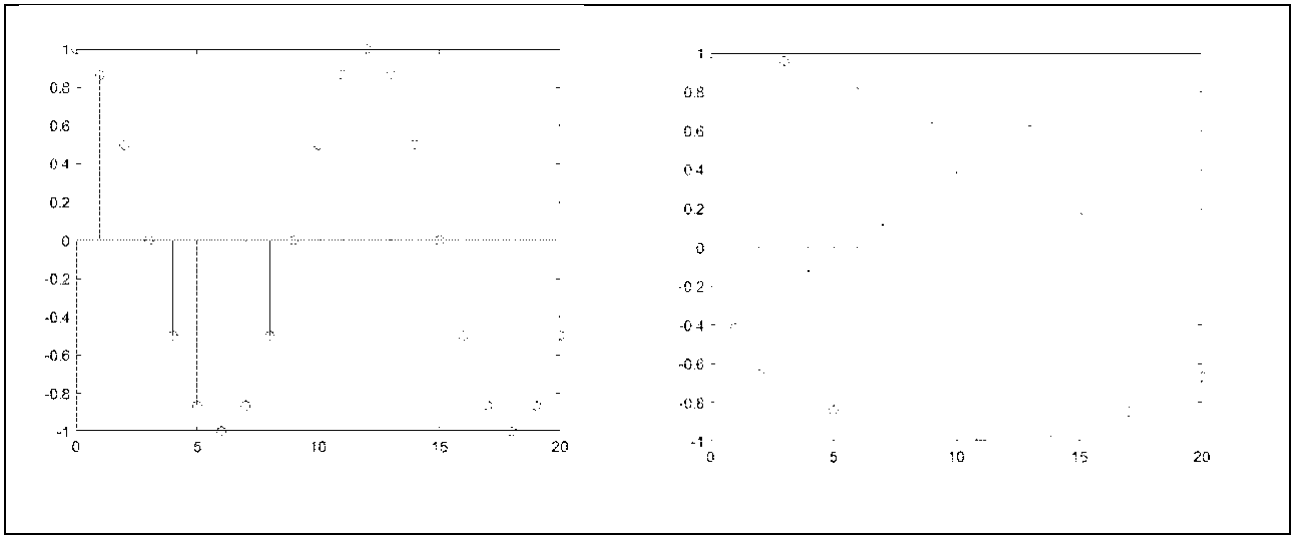
Analysis:

Because $\Omega=\pi/6$ $T=2\pi/\Omega=12$
So, the period of the 1st signal is 12.

Besides,
$\Omega=2$ $T=2\pi/\Omega=\pi$
But π is not an integer, so there is no period of the 2nd signal.

Results:





Comment:

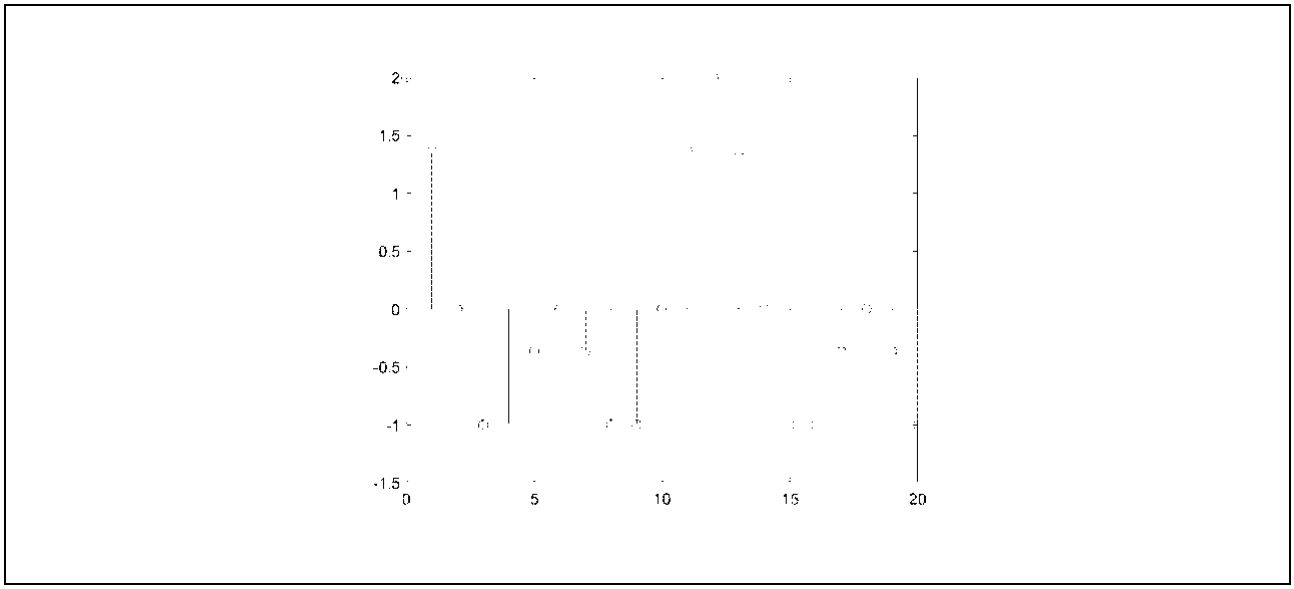
From this plot we could easily know the period of the signal is 12 which meet the theoretical analysis because the period is a positive int but in this condition is not meet the requirement.

Task 2

Procedure：

```
//
n = 0:1:20;
x = cos(pi * n / 6) + cos(pi * n / 3);
stem(n, x);
//
```

Results：



Comment:

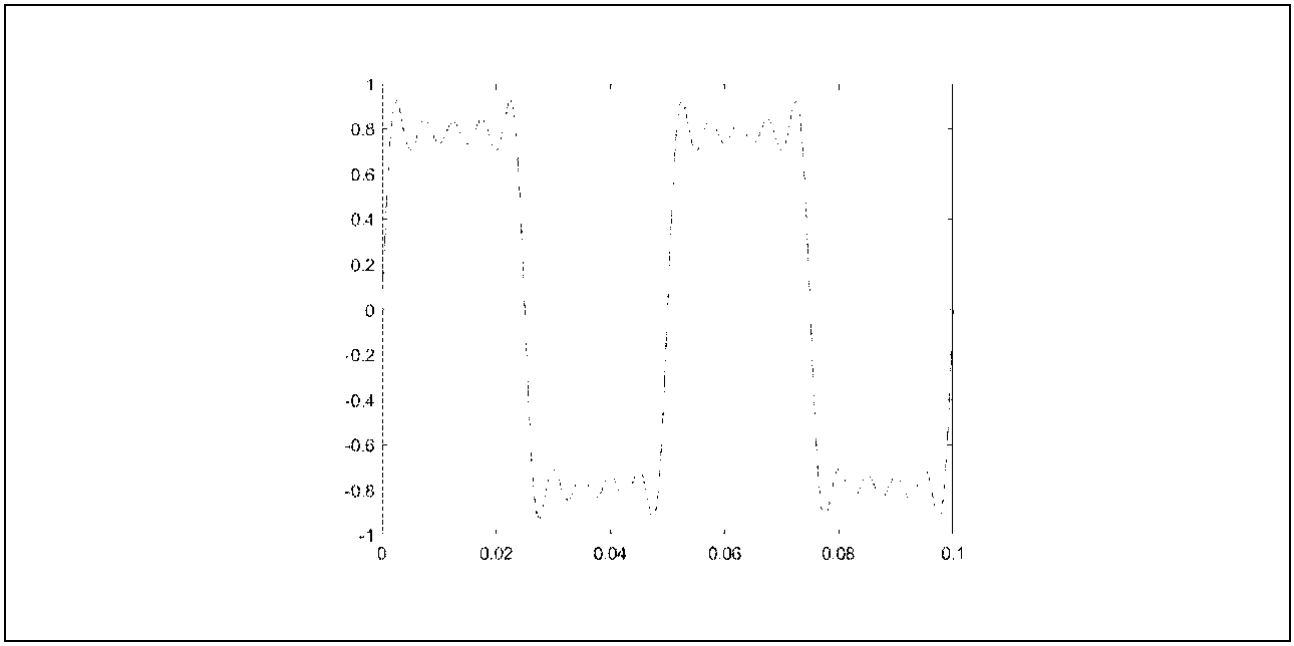
The general period of two sum of signal is the most lowest common multiple.

Task 3

Procedure：

```
//
F0=20;
T0=1/ F0;
N=-10:2:5;
t=linspace(0,2 * T0,200) ;
result = 0;
for n=-9:2:9
result=result+(-i/(2*n))*exp(i*2*pi*n*F0*t);
end
plot(t,result)
//
```

Results：



Comment:

From this plot, we got that the general period of two sum of signal is the most lowest common multiple.

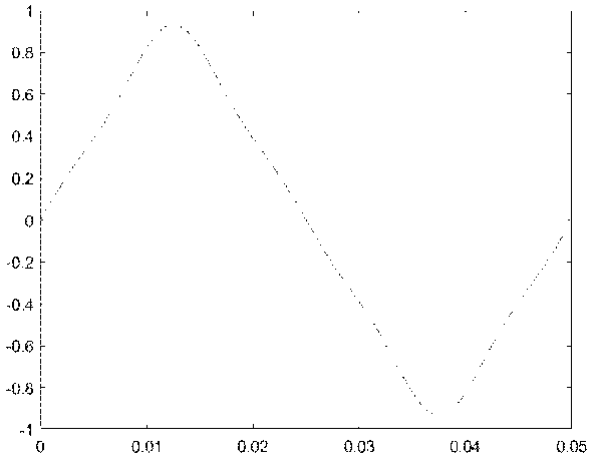
Task 4

Procedure：

```
//
f1 = 20;
t1 = 1 / f1;
t = linspace(0, t1, 200);
x = 0;
for k = 1:2:5
```

```
x = x + (8 / (pi * pi)) * (power(-1, (k - 1) / 2) / (k * k)) * sin(k * t * 2 * pi / t1);
end
plot(t,x)
//
```

Results：



Comment:

From this plot, we got when K is 5 The signal is approximately a triangular wave.

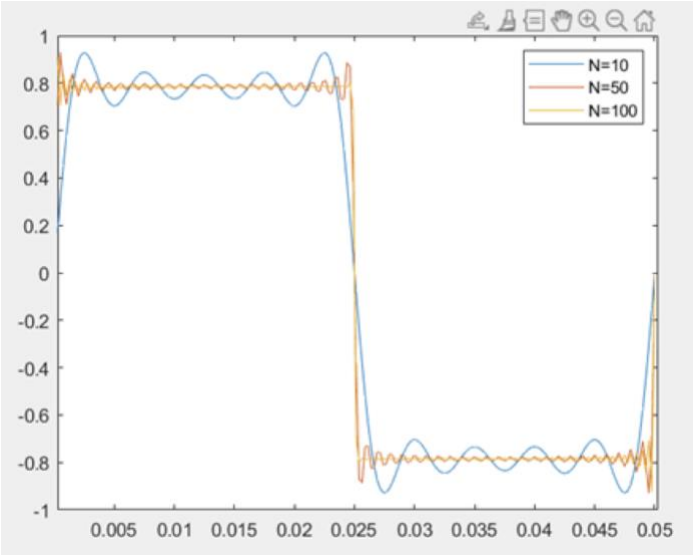
Task 5(1)

Procedure：

```
//
F0=20;
T0=1/ F0;
N=-10:2:10;
t=linspace(0,T0,200) ;
result = 0;
for n=-9:2:9
result=result+(-i/(2*n))*exp(i*2*pi*n*F0*t);
end
plot(t,result)
>> hold on
>> F0=20;

T0=1/ F0;
N=-49:2:49;
t=linspace(0,T0,200) ;
result = 0;
for n=-49:2:49
result=result+(-i/(2*n))*exp(i*2*pi*n*F0*t);
end
plot(t,result)
>> hold on
>> F0=20;
T0=1/ F0;
```

```
N=-100:2:100;
t=linspace(0,T0,200) ;
result = 0;
for n=-99:2:99
result=result+(-i/(2*n))*exp(i*2*pi*n*F0*t);
end plot(t,result)
//
```

Results：



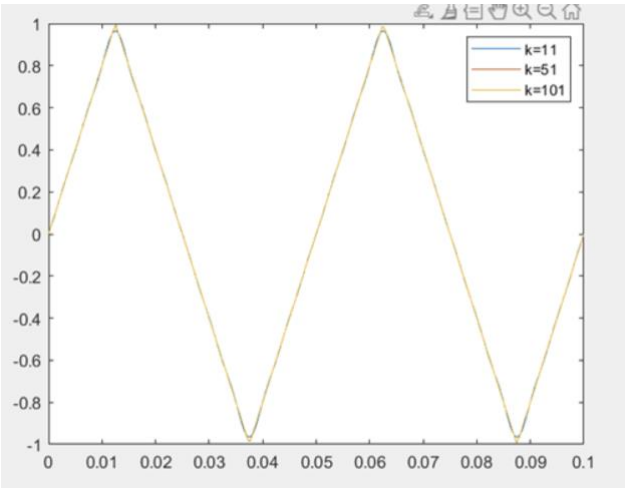
Task 5(2)

Procedure：

```
//
f1=20;

t1=1/f1;

result =0;

t= linspace(0,2*t1,200);
for k=1:2:11
result = result + (power(-1,((k-1)/2))/(k*k))*sin(k*2*pi*f1*t);
end
result=result*(8/pi/pi)
hold on

f1=20;
t1=1/f1;
result =0;
t= linspace(0,2*t1,200);
for k=1:2:51
result = result + (power(-1,((k-1)/2))/(k*k))*sin(k*2*pi*f1*t);
end
result=result*(8/pi/pi)
hold on
```

```
f1=20;
t1=1/f1;
result =0;
t= linspace(0,2*t1,200);
for k=1:2:101
result = result + (power(-1,((k-1)/2))/(k*k))*sin(k*2*pi*f1*t);
end
result=result*(8/pi/pi)
hold on
//
```

Results：



Comment:

From this plot, we got that the larger N and K is, the more accurate the graph of signal is.
So ideally we will choose N and K infinite in our formula.

Part 4: A summary of what you gained in the lab.

From this experiment, I know that period of signal must be a positive integer when it is a periodic function, I also learned the effects of the change of N and K, the larger N and K is, the more accurate signal is.

And I acknowledge that MATLAB is a useful tool for me to learn Signal Processing.

That's all, thank you!