**Lab 7**

**10/18/16**

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**Objective**

The objective of this lab is about understand how Fourier Series work, and analyze the error of a Fourier Series.

**Description**

We have 5 tasks to complete on this lab, the first task is just plot the square function, which we can just use the square command, task 2 we need to find out the error between the Fourier Series and the actual square function. We can observe that the big errors occur on the “impulse” area. On task 3, we record the errors from N=1 to N=10. We observe that as N goes higher, the error goes less and less besides when N is close to 0.5n. This is because since that we implement the square function by using cosine function, which means that it is a curve, we can reduce the curve, but we can hardly make it just like a square function.

On Task 3, we find the average value while N increases. As what we learned in Fourier Series, as N increases, the error should reduce. By doing this, we should use an array of length 2000 to record the value of the Fourier Series of each N, and we find the average value of each N. The graph is shown below.

**Result**

The result comes out right, we can check our result by checking the graph, the error should get less and less while N goes bigger, which is what we have shown below.

**Conclusion**

This lab helps us understand Fourier Series much better, even we know that as N increase, the error reduces, but I have never known the specific reason. By doing task 3 myself, I can be able to figure out why.

**MATLAB CODE**

clear all;

% Task 1

fs=1000;

f=1;

t=0:1/fs:2;

xsquare=square(2\*pi\*f\*t);

% Task 2

figure (1);

xs=0;

for n=-10:10

xs=xs+(2/pi)\*(1/(2\*n-1))\*cos((2\*n-1)\*(2\*pi\*f)\*t-(pi/2));

end;

subplot(221);

plot(t,xsquare); hold on;

plot(t,xs)

subplot(222);

plot(t,xsquare-xs);

% Task 3

for m=1:10

figure(m+1);

xs=0;

for n=m\*(-50):m\*50

xs=xs+(2/pi)\*(1/(2\*n-1))\*cos((2\*n-1)\*(2\*pi\*f)\*t-(pi/2));

end;

subplot(221);

plot(t,xsquare); hold on;

plot(t,xs)

subplot(222);

plot(t,xsquare-xs);

end;

% Task 4

arr=[50,100,150,200,250,300,350,400,450,500];

count = 0;

list = zeros(10);

alist = 1;

sum = 0;

sum1 = 0;

for N=50:50:500;

for n=-N:N

sum=sum+(2/pi)\*(1/(2\*n-1))\*cos((2\*n-1)\*(2\*pi\*f)\*t-(pi/2));

end;

arx=(xsquare-sum).^2;

for i=1:2000

sum1 = sum1 +arx(i);

end

sum1 = sum1/2000;

list(alist) = sum1;

alist = alist + 1;

sum = 0;

sum1 = 0;

end

figure(12);

plot(arr, list);

**Plots**





