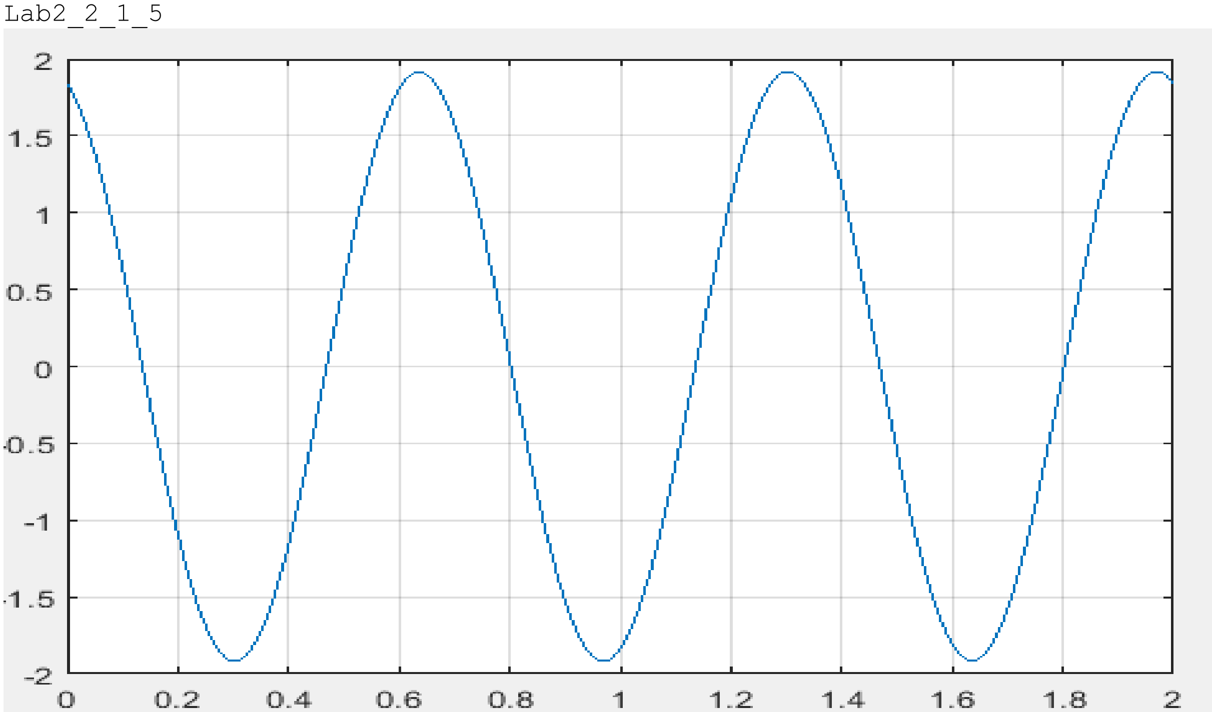
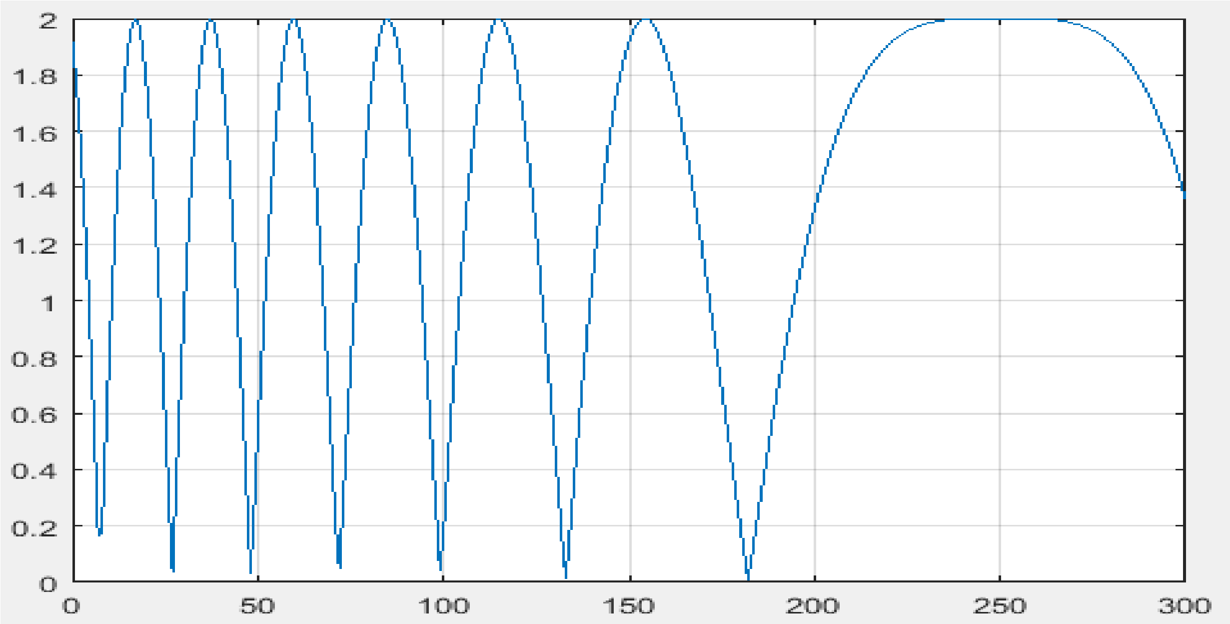
```
diary on
format compact
%Johnny Li
%EEL3135 Fall 2018
%Lab 2 Part 2

%2.1.1
%Question: What is the length of the reflected path as a function of xv?
%The length of reflected path can be found with two Pythagorean Theorem
%using its own components, as given:
%dup=sqrt((dxr-0)^2+(dyr-dt)^2) ddown=sqrt((dxr-xv)^2+(dyr-0)^2)
%t=(0,1500) and r=(100,900)
%Therefore, dr=dup+ddown and as a function of xv:
%dr=sqrt[(dxr-0)^2+(dyr-dt)^2]+sqrt[(dxr-xv)^2+(dyr-0)^2]

%2.1.2
%Question: What is the time delay of the direct path as a function of xv?
%The length of the direct path is found using the Pythagorean Theorem:
%dd= sqrt(xv^2+dt^2)
%The amount of delay (in seconds) can be computed with t=d/c therefore,
%td=dd/c=sqrt(xv^2+dt^2)/(3*10^8) s

%The length of the reflected path is found using the Pythagorean Theorem:
%dup=sqrt((dxr-0)^2+(dyr-dt)^2) ddown=sqrt((dxr-xv)^2+(dyr-0)^2)
%dr=dup+ddown=sqrt[(dxr-0)^2+(dyr-dt)^2]+sqrt[(dxr-xv)^2+(dyr-0)^2]
%The amount of delay (in seconds) can be computed with t=d/c therefore,
%tr=dr/c=(sqrt[(dxr-0)^2+(dyr-dt)^2]+sqrt[(dxr-xv)^2+(dyr-0)^2])/(3*10^8) s

%Subtract the above two expressions from each other to express the
%difference in time delay between the two paths as a function of xv.
%t=tr-td=(sqrt[(dxr-0)^2+(dyr-dt)^2]+sqrt[(dxr-xv)^2+(dyr-0)^2]
%         -sqrt(xv^2+dt^2))/(3*10^8) s

%2.1.3
%The phase difference between the two paths as a function of xv with
%frequency f0=150Hz.
%Time delay is equivalent to phase shift with t=-p/w, which translate to
%-tw=p. The value of w=2pif, therefore, p=-t2pif which expanded is
%p=-(2pi150000000)((sqrt[(dxr-0)^2+(dyr-dt)^2]+sqrt[(dxr-xv)^2+(dyr-0)^2]
%              -sqrt(xv^2+dt^2))/(3*10^8))
%Simplify p=-(300000000pi)((sqrt[dxr^2+(dyr-dt)^2]+sqrt[(dxr-xv)^2+dyr^2]
%              -sqrt(xv^2+dt^2))/(3*10^8))

%2.1.4
%Find at least one value of xv that will result in signal cancellation.
%The value of about xv=183 will result in signal cancellation.
%p=-(300000000pi)((sqrt[100^2+(900-1500)^2]+sqrt[(100-xv)^2+900^2]
%              -sqrt(xv^2+1500^2))/(3*10^8))=0

type Lab2_2_1_5

%Lab2-2.1.5
%Plot 3 periods of rv(t)=s(t-t1)+s(t-t2), where the phase is 0, amplitude 1
%and cyclic frequency 150MHz
```

```
%Position of transmitter
dt=1500;
%Position of reflector
dxr= 100;
dyr= 900;
%Position of vehicle is 0 meters
xv=0;
%Frequency is given as 150MHz
f=150000000;
%Speed of light
c=3*10^8;

%Length of reflector path
dr=sqrt((dxr-0)^2+(dyr-dt)^2)+sqrt((dxr-xv)^2+(dyr-0)^2);
%Length of transmitter path
dd= sqrt(xv^2+dt^2);
%Time delay of transmitter
td=dd/c;
%Time delay of reflector
tr=dr/c;
%Period shift of signal
t=tr-td;
%Time interval
tt=0:1/(11025*f):3*(1/f);

%Function rv
rv=cos(2*pi*f*(tt-td))+cos(2*pi*f*(tt-tr));
%Plot result on gird
plot(tt,rv);
grid on;
```

Lab2_2_1_5



```
%As seen on the plot, the amplitude is approximately 2.

type Lab2_2_1_6

%Lab2-2.1.6
%Generate the time delays, create the complex amplitudes, and then add the
%complex amplitudes.

%Position of transmitter
dt=1500;
%Position of reflector
dxr= 100;
dyr= 900;
%Frequency is given as 150MHz
f=150000000;
%Speed of light
c=3*10^8;
%Vehicle position over the interval from 0 meters to 300 meters.
xv=0:1:300;

%Length of reflector path
dr=sqrt((dxr-0)^2+(dyr-dt)^2)+sqrt((dxr-xv).^2+(dyr-0)^2);
%Length of transmitter path
dd= sqrt(xv.^2+dt^2);

%Create Time delays
%Time delay of transmitter
td=dd/c;
%Time delay of reflector
tr=dr/c;

%Create and Add complex amplitudes
%rv=cos(2*pi*f*td)+cos(2*pi*f*tr);
rv=exp(-j*2*pi*f*td)+exp(-j*2*pi*f*tr);
rv=abs(rv); %Told by TA to do this

%Plot signal strength (amplitude) versus vehicle position
plot(xv,rv);
grid on;

Lab2_2_1_6
```



%2.1.7
%Question: What are the largest and smallest values of received signal
%strength?
%From viewing the plot, the largest signal strength (amplitude) is 2 whiles
%the smallest signal strength is 0.

%Question: Are there vehicle positions where we get complete signal
%cancellation, that is, where the received signal is zero? If so,does one
%of them match your hand calculation?
%Yes, at the approximate the hand calculated vehicle position, 183,
%there is complete signal cancellation.