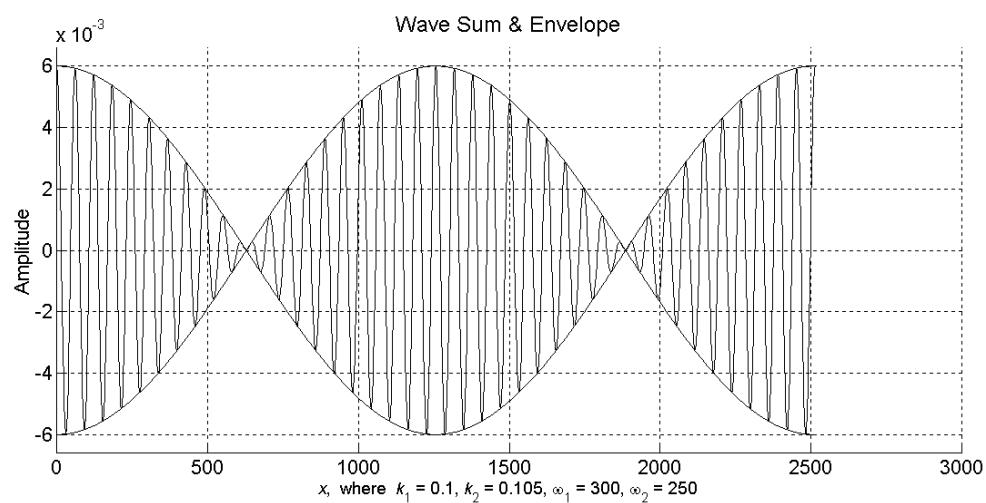
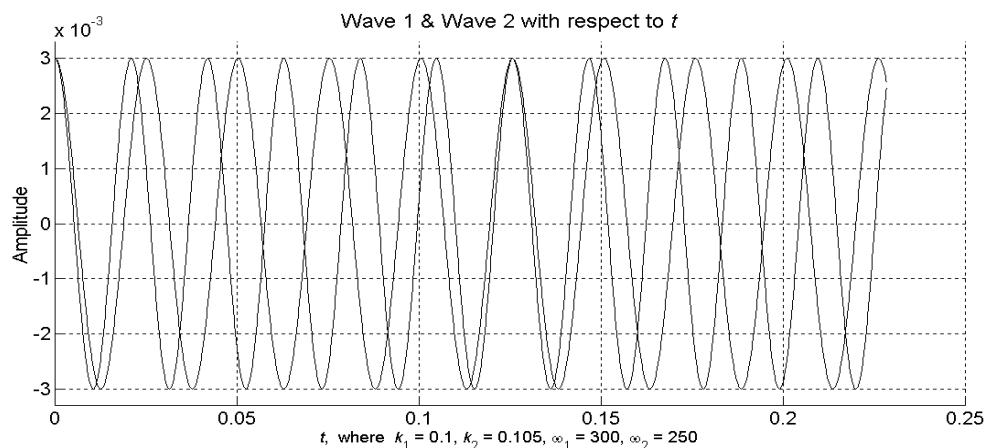
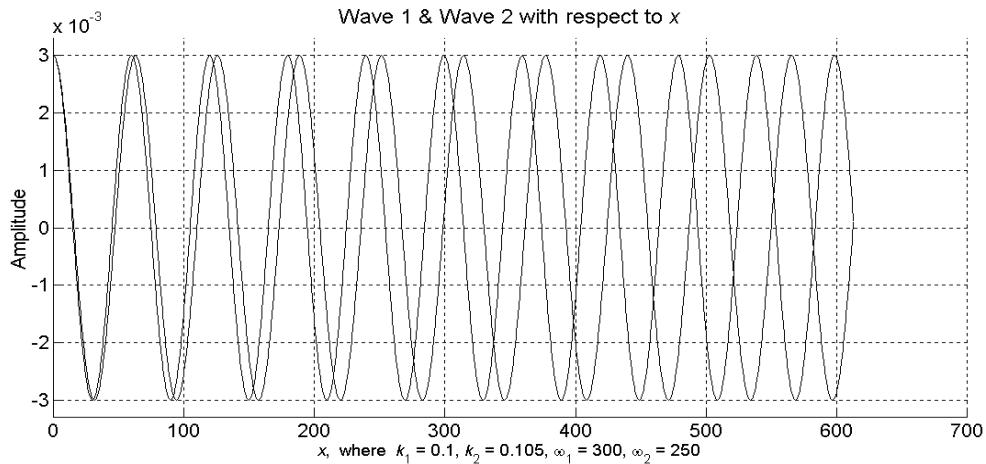


# Wave Summing Example

Two waves are added to produce a "beat function".

$$\Psi_1(x, t) = 0.003 \sin(0.100x - 300t), \quad \Psi_2(x, t) = 0.003 \sin(0.105x - 250t)$$



## Matlab Code:

```
function wavesum(Amplitude,k1,k2,Omegal,Omega2)
% wavesum(Amplitude,k1,k2,Omegal,Omega2)
% This function creates three wave function plots.
% 1) Two wave functions are plotted with respect to x
% 2) Two wave functions are plotted with respect to t
% 3) The sum of the two wave functions is plotted along
%     with the function envelope.

PlotWindowSize = [1400,550]; % plot window size in pixels
X=[]; Y1=[]; Y2=[]; x=0; t=0; % initialize variables
Dk = k1-k2; Dw = Omegal-Omega2;
Kav = (k1+k2)/2; Wav = (Omegal+Omega2)/2;
Domain1 = 4*pi/abs(Dk); % domain to be plotted - sum and envelope
Domain2 = 20*pi/abs(Kav); % domain to be plotted - waves with respect to x
Domain3 = 20*pi/abs(Wav); % domain to be plotted - waves with respect to t
Resolution = .0005; % sets the resolution

while x < Domain1, % fill the matrices

% ***** THE EQUATIONS FOR SUM AND ENVELOPE: *****
y1 = 2*Amplitude * cos((Dk/2)*x - (Dw/2)*t) * cos(Kav*x - Wav*t);
y2 = 2*Amplitude * cos((Dk/2)*x - (Dw/2)*t);

X = [X,x]; Y1 = [Y1,y1]; Y2 = [Y2,y2]; % form matrices for X and complex Y values
x = x+(Domain1*Resolution); % controls the resolution of the plots
end % end of "while" statements

% ***** THE PLOT OF SUM AND ENVELOPES *****
figure('Position',[10 100 PlotWindowSize(1) PlotWindowSize(2)])
hold on
plot(X,Y1); plot(X,Y2); plot(X,-Y2); % variables to plot
set(gca,'FontSize',16)
grid on % make the grid visible
xlimits = get(gca,'Xlim');
ylimits = get(gca,'Ylim');
set(gca,'Ylim',ylimits*1.1); % add a buffer at the top and bottom of the plot

title('Wave Sum & Envelope','FontSize',18,'Color',[0 0 0])
xStr = ['{\it x}', where {\it k}{_1} = num2str(k1) , {\it k}{_2} = num2str(k2) , \omega{_1} = num2str(Omegal) , \omega{_2} = num2str(Omega2)];
xlabel(xStr,'FontSize',14, 'Color',[0 0 0])
ylabel('Amplitude','FontSize',16, 'Color',[0 0 0])
hold off

% ***** WAVE 1 & WAVE 2 *****
X=[]; Y1=[]; Y2=[]; x=0; t=0; % reinitialize variables
while x < Domain2, % domain

% ***** THE EQUATIONS BEFORE SUMMING: *****
y1 = Amplitude * cos(k1*x - Omegal*t);
y2 = Amplitude * cos(k2*x - Omega2*t);

X = [X,x]; Y1 = [Y1,y1]; Y2 = [Y2,y2]; % form matrices for X and complex Y values
x = x+(Domain2*Resolution); % controls the resolution of the plots
end % end of "while" statements
```

```

% ***** PLOT WAVE 1 & WAVE 2 with respect to X *****
figure('Position',[10 10 PlotWindowSize(1) PlotWindowSize(2)])
hold on
plot(X,Y1); plot(X,Y2); % variables to plot
set(gca,'FontSize',16)
grid on % make the grid visible
xlimits = get(gca,'Xlim');
ylimits = get(gca,'Ylim');
set(gca,'Ylim',ylimits*1.1); % add a buffer at the top and bottom of the plot

title('Wave 1 & Wave 2 with respect to {\itx}', 'FontSize',18, 'Color',[0 0 0])
xStr = ['{\itx}, where {\itk}{_1} = ' num2str(k1) ', {\itk}{_2} = ' num2str(k2) ', \omega{_1} = '
num2str(Omega1) ', \omega{_2} = ' num2str(Omega2)];
xlabel(xStr, 'FontSize',14, 'Color',[0 0 0])
ylabel('Amplitude', 'FontSize',16, 'Color',[0 0 0])
hold off

% ***** WAVE 1 & WAVE 2 with respect to T *****
X=[]; Y1=[]; Y2=[]; x=0; t=0; % reinitialize variables
%while t < 1.9/Domain,
%    % domain (as a function of period)
while t < Domain3, % domain (as a function of period)

% ***** THE EQUATIONS BEFORE SUMMING: *****
y1 = Amplitude * cos(k1*x - Omega1*t);
y2 = Amplitude * cos(k2*x - Omega2*t);

X = [X,t]; Y1 = [Y1,y1]; Y2 = [Y2,y2]; % form matrices for X and complex Y values
t = t+(Resolution*Domain3); % controls the resolution of the plots
end % end of "while" statements

% ***** PLOT WAVE 1 & WAVE 2 with respect to T *****
figure('Position',[10 10 PlotWindowSize(1) PlotWindowSize(2)])
hold on
plot(X,Y1); plot(X,Y2); % variables to plot
set(gca,'FontSize',16)
grid on % make the grid visible
xlimits = get(gca,'Xlim');
ylimits = get(gca,'Ylim');
set(gca,'Ylim',ylimits*1.1); % add a buffer at the top and bottom of the plot

title('Wave 1 & Wave 2 with respect to {\itt}', 'FontSize',18, 'Color',[0 0 0])
xStr = ['{\itt}, where {\itk}{_1} = ' num2str(k1) ', {\itk}{_2} = ' num2str(k2) ', \omega{_1} = '
num2str(Omega1) ', \omega{_2} = ' num2str(Omega2)];
xlabel(xStr, 'FontSize',14, 'Color',[0 0 0])
ylabel('Amplitude', 'FontSize',16, 'Color',[0 0 0])
hold off

```