```
%
% dispersion in superposition of 2 elementary waves
%

clear
fs = 14;
% ipde=1 : 1st order wave equation, ipde=2 : linearized KdV
c = 1; k1 = 1.9; k2 = 2.1;
nperiod = 16; ms = 10;
xmin = 0; xmax = nperiod*2*pi; npt = 200; dx = (xmax-xmin)/(npt*nperiod);
x = xmin:dx:xmax;
ymin = -2.1; ymax = 2.1;
y1 = cos(k1*x);
subplot(5,1,1); plot(x,y1,'-k'); axis([xmin xmax ymin ymax])
title('y_1 = cos(k_1x) , k_1 = 1.9' , 'fontsize' , fs)
y2 = cos(k2*x);
subplot(5,1,2); plot(x,y2,'-k'); axis([xmin xmax ymin ymax])
title('y_2 = cos(k_2x) , k_2 = 2.1' , 'fontsize' , fs)
y3 = y1 + y2;
subplot(5,1,3); plot(x,y3,'-k'); axis([xmin xmax ymin ymax])
title('y_3 = cos(k_1x) + cos(k_2x) , k_1 = 1.9 , k_2 = 2.1' , 'fontsize' , fs)
%
tmin = 0; dt = 0.05; tmax = 7; ntime = (tmax - tmin)/dt;
M = [];
for itime = 1:ntime+1
    for ipde = 1:2
        t = tmin + dt * (itime-1);
        if ipde--1; omega1 = c*k1; omega2 = c*k2; end
        if ipde==2; omega1 = c*k1 + k1^3; omega2 = c*k2 + k2^3; end
        a = k1*x - omega1*t; y1 = cos(a); xx1 = (omega1/k1)*t;
        b = k2*x - omega2*t; y2 = cos(b); xx2 = (omega2/k2)*t;
    y3 = cos(a) + cos(b); xx3 = ((omega2-omega1)/(k2-k1))*t;
    y4 = 2*cos(((k2-k1)*x-(omega2-omega1)*t)/2);
    if ipde==1; subplot(5,1,4); end
    if ipde==2; subplot(5,1,5); end
    plot( x , y3 , '-k' , x , y1 , '-r' , x , y2 , '-b' , x , y4 , '--k' , ...
        xx1 , 1 , 'rx' , xx2 , 1 , 'bo' , xx3 , 2 , 'k^' , 'Markersize' , ms)
    axis([xmin xmax ymin ymax])
    if ipde==1; title('ex 1 : \phi_t+\phi_x=0 , \phi(x,0) = y_3(x) , v_{ph} = 1
     , v_{gr} = 1' ,...
            'fontsize',fs); end
    if ipde==2; title('ex 2 : \phi_t+\phi_x=\phi_{xxx} , \phi(x,0) = y_3(x) ,
     v_{ph} = 4.61, 5.41 , v_{gr} = 12.01' , 'fontsize',fs); end
    F = getframe;
    M = [M F];
    end
end
```