Develop a Working Model (WM) simulation of a stick-slip drag-sled friction testing device. Attach a screen shot of your WM device.

Your device should contain the following –

a) a driver block that translates horizontally at 3.4 cm/sec,
b) a drag-sled with mass 12.5 kg and length 14.9 cm that slides horizontally on a large plate, and
c) a horizontal tension spring with 742.5 N/m stiffness that connects the driver and drag-sled.

1) To simulate dry metal-on-metal contact, use coefficient of static friction $\mu_S = 0.4$ and coefficient of dynamic friction $\mu_D = 0.3$ for both the drag-sled and the plate. Provide MATLAB graphs of drag-sled position, velocity, acceleration and friction force as functions for time.

What is the maximum absolute acceleration ignoring blips? $a_{\text{MAX}}$ ________________ 1.01 m/s$^2$

2) Repeat to simulate Neolite (standard footwear slip testing material) on a tile floor using coefficients of static friction $\mu_S = 0.9$ and dynamic friction $\mu_D = 0.6$. Discuss differences in between parts 1) and 2).

What is the maximum absolute acceleration ignoring blips? $a_{\text{MAX}}$ ________________ 2.95 m/s$^2$

3) Experiment with height above the plate at which you attach the spring to the drag-sled to investigate how it might influence your results. **Be certain to keep the spring horizontal.** Provide a brief discussion and plots.

What is the ratio of attachment height (h) divided by drag-sled length (L) that causes tipping expressed as function of static coefficient of friction $\mu_S$?

$$h/L = \frac{1}{2\mu_S}$$

Are results different if you attach the spring too low? ________________ no

FBD of drag-sled at tipping

$$\Sigma M \text{ CCW positive about P} +mg (L/2) - Fs h = 0$$
$$\Sigma F \text{ right positive} +Fs - \mu N = 0$$
$$\Sigma F \text{ up positive} +N - mg = 0$$

$$F_s h = \frac{mgL}{2}$$
$$\frac{h}{L} = \frac{mg}{2F_s} = \frac{1}{2\mu}$$
% hw12.m - plot stick-slip for ME 481 H12
% HJSIII, 11.04.01

clear

% part 1
% load file and rip data
raw = load( 'hw12_01_cut.txt' );
t = raw(:,1);
pos = raw(:,2);
vel = raw(:,3);
acc = raw(:,4);
fric = raw(:,8);

% plot
figure( 1 )
clf
subplot( 4,1,1 )
plot( t,pos,'r' )
ylabel( 'Pos [cm]' )
title( 'Stick-slip for mus=0.4, mud=0.3' )

subplot( 4,1,2 )
plot( t,vel,'g' )
ylabel( 'Vel [cps]' )

subplot( 4,1,3 )
plot( t,acc,'b' )
ylabel( 'Acc [cpss]' )

subplot( 4,1,4 )
plot( t,fric,'k' )
ylabel( 'Fric [N]' )
xlabel( 'Time [sec]' )

% part 2
% load file and rip data
raw = load( 'hw12_02_cut.txt' );
t = raw(:,1);
pos = raw(:,2);
vel = raw(:,3);
acc = raw(:,4);
fric = raw(:,8);

% plot
figure( 2 )
clf
subplot( 4,1,1 )
plot( t,pos,'r' )
ylabel( 'Pos [cm]' )
title( 'Stick-slip for mus=0.9, mud=0.6' )

subplot( 4,1,2 )
plot( t,vel,'g' )
ylabel( 'Vel [cps]' )

subplot( 4,1,3 )
plot( t,acc,'b' )
ylabel( 'Acc [cpss]' )

subplot( 4,1,4 )
plot( t,fric,'k' )
ylabel( 'Fric [N]' )
xlabel( 'Time [sec]' )