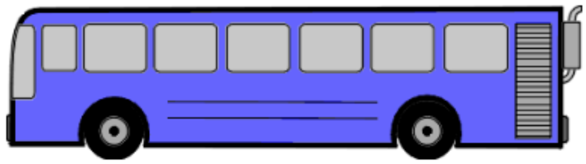
HW Matlab Workshop at Vistec (1 Feb 2019), Dr. Kan Kanjanapas
Submit a homework report + code to oakmj2000@yahoo.com ☺

1. Find 2D datasets from your research work and then visualize dataset by (10 points)
    - Create 2D plot (multiple lines).
    - Add axes label, title, legend (if any), text/graphic annotation (if any), etc to complete your plot.

2. Find 3D datasets from your research work and then visualize dataset by (20 points)
    - Create 3D subplot 2 row, 2 column
    - Subplot(2,2,1) → Surface or 3D line plot.
    - Any other subplots are the projection on x-y, y-z, z-x planes.
    - Add axes label, title, legend (if any), text/graphic annotation (if any), etc to complete your plot

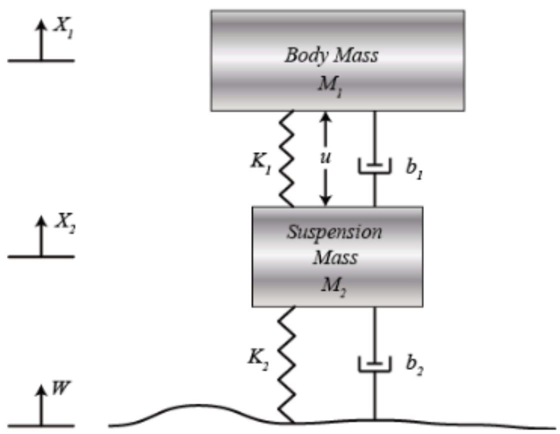
3. Solve this system of differential equation (40 points)

Physical setup



Designing an automotive suspension system is an interesting and challenging control problem. When the suspension system is designed, a 1/4 model (one of the four wheels) is used to simplify the problem to a 1-D multiple spring-damper system. A diagram of this system is shown below. This model is for an active suspension system where an actuator is included that is able to generate the control force U to control the motion of the bus body.

Model of Bus Suspension System (1/4 Bus)



System parameters

(M1)	1/4 bus body mass	2500 kg
(M2)	suspension mass	320 kg
(K1)	spring constant of suspension system	80,000 N/m
(K2)	spring constant of wheel and tire	500,000 N/m
(b1)	damping constant of suspension system	350 N.s/m
(b2)	damping constant of wheel and tire	15,020 N.s/m
(U)	control force	

Equations of motion

From the picture above and Newton's law, we can obtain the dynamic equations as the following:

$$M_1\ddot{X}_1 = -b_1(\dot{X}_1 - \dot{X}_2) - K_1(X_1 - X_2) + U \quad (1)$$

$$M_2\ddot{X}_2 = b_1(\dot{X}_1 - \dot{X}_2) + K_1(X_1 - X_2) + b_2(\dot{W} - \dot{X}_2) + K_2(W - X_2) - U \quad (2)$$

- Part 3.1) Solve for x1(t) and x2(t) during t = 0 to 60 s, given constant U(t) = 100 N for this period of time and W(t) = 0. (Using ode45).

- Part 3.2) Solve for x1(t) and x2(t) during t = 0 to 60 s, given constant U(t) = 100 N for this period of time and W(t) = 0. (Using Simulink).

- Create a plot to compare solutions from both methods.

- Discuss how will you verify the solutions whether they are correct or not?. Show numerical verification of the solutions!

4. Find a model for this particular dataset (30 points)
   x = [0:1:20];
   y =

-0.0402232978174774	2.62664901397530	4.55363804731337	5.92211764557511
6.99884138519817	7.71040620194160	8.28961347883921	8.78067945327101
9.12893316871713	9.45721943523332	9.46878478278629	9.64053487721655
9.72263805425853	9.70092973964941	9.82809592409848	9.79917609254482
9.95972130599750	9.89463093022839	9.95983883223084	9.93931389892576
9.99038851796581			

   Show a curve-fitting plot (data vs estimated model) and R-squared value.