**Initial report**

**1.Basic information**

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**Problem number：** 3

**2.Modeling**

Assume that when d (t) is zero, the equilibrium position is x (t)=0. The downward direction of x (t) and d (t) is positive. It can be obtained through force analysis:



Here, d(t) is input, x(t) is output and x,x’,x’’ are the state variables. Besides, in reality, d(t) can be considered as the uneven road surface, x(t) can be viewed as the height of car, M is the mass of car, k is the elastic coefficient of spring and b is the piston damping.

The corresponding transfer function is



As for time domain solution, we firstly transform it to state space model and let z(t) be the intermediate variable:

Then we derive its time domain solution as below:

Our goal is to design the appropriate control law so that the vehicle accommodates a large bump at high speeds and a small bump at low speeds.

When M = 1 kg, b = 4 N s/m, and k = 18 N/m, the step response is shown below:

