AIS2002 Reguleringsteknikk

Øving 1 Dato: 28.08.2025

Wheel Suspension System

Figure 1 shows the wheel suspension system for a car. The wheel follows the road given by the position $x_0(t)$.

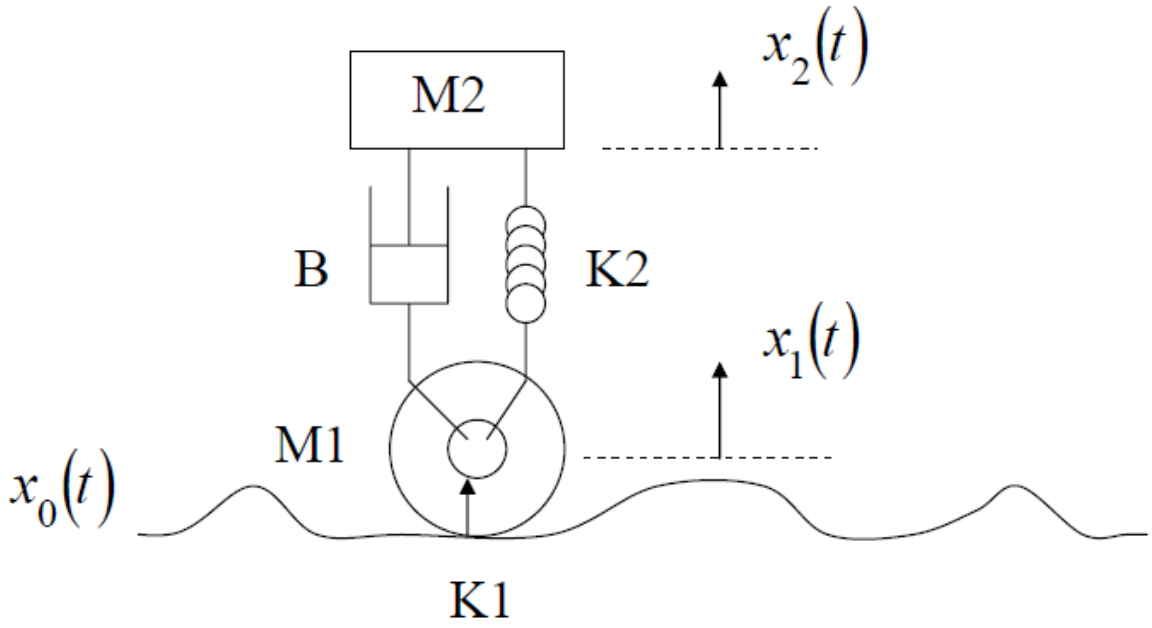

Figure 1: Wheel suspension system

a) Apply Newton's laws to each of the two masses to derive the equations for the vertical motion of the wheel and the car, using the symbols in Figure 1.

b) Use the values $M_1 = 40\,kg$, $M_2 = 250\,kg$, $B = 500\,Ns/m$, $K_1 = 20\,000\,N/m$ and $K_2 = 10\,000\,N/m$, and write the equations on numerical form, separating x_1 and x_2.

c) Derive the transfer function from the road position $x_0(t)$ to the car motion $x_2(t)$,

$$h(s) = \frac{x_{2(t)}}{x_{0(t)}}$$

d) You can now tune the different parameters to obtain your perfect driving experience. Write a simulation diagram for the model. Analyse the model in Simulink.

e) Introduce the states $z_1 = x_1$, $z_2 = \dot{x}_1$, $z_3 = x_2$, $z_4 = \dot{x}_2$, and $u = x_0$. Write the equations derived above as four first order differential equations. With $x_0(t)$ as input to the system and wheel position x_1 and car position x_2 as measurements, introduce the state space model.