Exercise Sheet 1

Literature:

G.F. Franklin, J.D. Powell and A. Emami-Naeini: *Feedback Control of Dynamic Systems*, 6th edition, pp. 431-442, pp. 452-460.

Exercise 1

The figure illustrates two masses (carts) connected via a lossless spring, moving at a surface with no

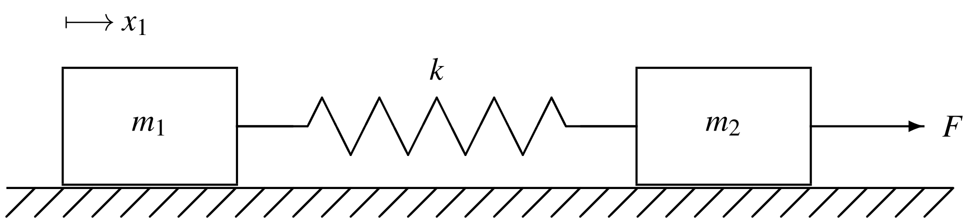

Figure 1: Two coupled carts

friction.

1. Derive a state space model for this system, assuming that the force F is considered as input, and the velocity $v_1 = \dot{x}_1$ is considered as output.
2. Compute the eigenvalues for the system matrix. Where in the complex plane are these located, and why?
3. Compute the transfer function for the system based on the state space equation.

Exercise 2

A model of a balancing triangle has the transfer function:

$$G(s) = -\frac{(s+11)(s-11)}{(s+30)^2(s+5)(s-5)} = \frac{-s^2+121}{s^4+60s^3+875s^2-1500s-22500}$$

1. Find a state space representation for this system, applying the MATLAB™ functions `tf` and `ssdata`. If you have the symbolic toolbox, the process can be simplified by first defining `s` symbolically by the command `s=tf('s')`.
2. Compute the poles and zeros of the system, using the MATLAB™ functions `zero` and `pole`. Compare the poles with the eigenvalues (MATLAB™ function: `eig`) of the state space system matrix (A) from 1.