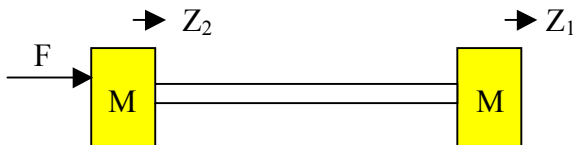


Feedforward Control

Short Course HW 2 (Minimum Phase problem)

Consider the system of two masses (M) connected by a spring



The input u is force F and the output y is displacement Z_2 .

- 1) Obtain a state space model with one FEM element for the rod. Find the poles and zeros of the system
- 2) Find the transfer function of the system (ss2tf) and verify the poles and zeros of the TF
- 3) The desired output acceleration d^2y/dt^2 is of the form $A\sin(\omega t)$. Choose A such that the output reaches 1 ($y=1$) after one period $T = 10$ s. The acceleration remains zero after the time period T . Obtain the velocity profile of the output as well as the position profile.
- 4) Find the internal dynamics of the system. Compare the poles of the internal dynamics with the zeros of the original system
- 5) Solve the internal dynamics; find the reference state trajectory X_{ref} and the inverse input U_{inv} .
- 6) Design your favorite feedback system. Simulate the output tracking of the system with this feedback (LSIM in MATLAB).
- 7) Add feedforward to feedback and simulate again.
- 8) Compare tracking results with and without feedforward (Steps 6 and 7).
- 9) Modify the system slightly before simulation (after finding feedforward and feedback controller to simulate parameter uncertainties). For example, change M by $\pm 1\%$. Repeat step 8.
- 10) Comparatively evaluate the feedforward and feedback inputs in Step 9.