

ME41055

Multibody Dynamics B

Spring Term 2018, Tue 13:45-15:30, room 3mE-IZ L, 4 ECTS credits.

Homework Assignment 1 (HW1)

The model of a double pendulum consists of two slender rigid bars made out of perspex ($\rho = 1180 \text{ kg/m}^3$), each with length $l = 0.55 \text{ m}$ and a rectangular cross section of $w = 50 \text{ mm}$ by $t = 4 \text{ mm}$. The first bar is connected to the ground by a cylindrical hinge in A, the left side of the bar. The left end of the second bar, B, is connected to the right end of the first bar by a second cylindrical hinge. We assume a gravitational field operating in the *horizontal* direction with a field strength of $g = 9.81 \text{ N/kg}$.

- a. Derive the equations of motion together with the joint constraint equations for this system.

Calculate for each of the following initial conditions the linear and angular accelerations of the centre of mass of the bodies, together with the forces of interaction in the joints (joint constraint forces).

- b. Both bars vertical up and zero speeds.
- c. Both bars horizontal to the right and zero speeds.
- d. Both bars horizontal and with an initial angular speed of $\omega = 60 \text{ rpm}$ on both bars. Also calculate the initial velocities of the centre of mass of the two bodies in this state.

Note: Be sure to present your results by both a value *and* a dimension, like 5 m/s or 18 N .