ME41055
Multibody Dynamics B

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

Homework Assignment 7 (HW7)

Consider the quick-return mechanism from Figure 1. The crank 2 drives via a slider 3 the rocker 4, and finally the connecting bar 5 moves the slider 6. The centre of mass of link i is denoted by G_i. The specification of the mechanism is as follows: $O_2A = 0.2$ m, $O_4B = 0.7$ m, $BC = 0.6$ m, $O_4O_2 = 0.3$ m, $O_4G_4 = 0.4$ m, $BG_5 = 0.3$ m, $y_c = 0.9$ m, $m_3 = 0.5$ kg, $m_4 = 6$ kg, $m_5 = 4$ kg, $m_6 = 2$ kg, $J_4 = 10$ kgm^2, $J_5 = 6$ kgm^2, $F = 1$ kN, $T = 0$. The reduced mass moment of inertia at the balanced crank ($G_2 = O_2$) is $J_2 = 100$ kgm^2. The initial angular velocity of the crank is $\omega_2 = 75$ rpm CCW at $\theta_2 = 0$ deg. We assume no friction and zero gravity.

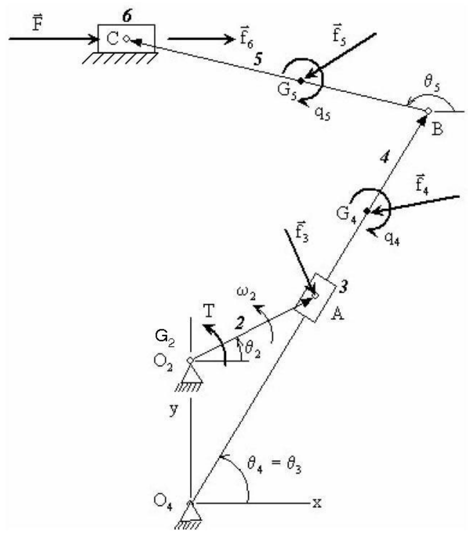

Figure 1 A Quick-Return Mechanism

Determine the motion of the mechanism by numerical integration of the equations of motion. Derive these equations in terms of generalised coordinates and use the cut loop method for this closed loop system. Use the Coordinate Projection Method [1] to make the solutions fulfil the constraints. Try not to derive the equations of motion in an explicit form but evaluate your equations in a step-by-step manner.

Please address the following questions:

a. Describe your algorithm in words and formula's.

Show for two revolutions of the crank as a function of time:

b. - The angular speed of crank 2, rocker 4 and connecting bar 5.

c. - The sliding speed of slider 3 with respect to rocker 4.
- The horizontal position, speed and acceleration of slider 6.

d. - The normal force exerted by the slider 3 on the rocker 4.
- The normal force exerted by slider 6 on the ground.

Finally,

e. Which checks did you use in order to be sure that you have the correct answers?

Briefly discuss your results.

References

[1] Edda Eich-Soellner and Claus Führer. *Numerical Methods in Multibody Dynamics*. European Consortium for Mathematics in Industry. B.G.Teubner, Stuttgart, 1998.