# wb1413
# Multibody Dynamics B

Spring Term 2013, Thu 15:45-17:30, room CT-CZ G, 4 ECTS credits.

## Homework assignment 7

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, $m_6 = 1$ 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 $J_2 = 200$ kgm$^2$. The initial angular velocity of the crank is $\omega_2 = 150$ rpm CCW at $\theta_2 = 0$ deg. We assume no friction and zero gravity.

Determine the motion of the mechanism by numerical integration of the equations of motion. Derive these equations in a DAE form and stabilize the constraints by means of the Coordinate Projection Method [1]. Try not to derive the equations of motion in an explicit form but evaluate your equations in a step-by-step manner.

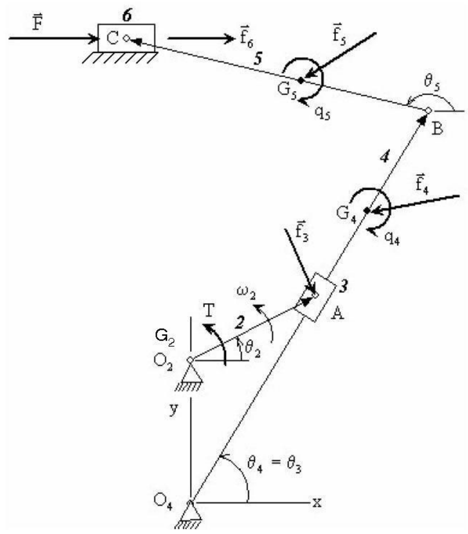


Figure 1 A Quick-Return Mechanism

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.

**Bonus Question:** The motion of this mechanism is clearly periodic, what is the period $T$ in seconds $\pm 0.25\%$.

## References


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