Dynamics of Mechanical Systems
Academic Year 2023/2024
Homework 2

Afonso Henrique, 98555 - afonso.henrique@tecnico.ulisboa.pt

1 Objectives

Use the program MUBOKAP, presented in class and made available in your dropbox to perform the kinematic analysis of the mechanism presented in the figure. Deliver the following information:

- Identify the system bodies, their body fixed coordinate systems and locate the XY frame.
- In the exploded views of each body identify the body fixed frames, points required to define the kinematic joints and provide their coordinates.
- Establish a set of initial positions and orientations of the bodies
- Build and present the input file required by the kinematic analysis program.
- Simulate the system with MUBOKAP and present the plots for the trajectories and time variation of the quantities listed in the description of your mechanical system.

If any dimension is missing or you feel as being required just measure it in the drawing and scale it appropriately.

2 Defining the system bodies, body fixed coordinate systems, and XY frame

For my student number, the mechanism to be used was number 4, and the chosen vector loops can be found in the following figure:

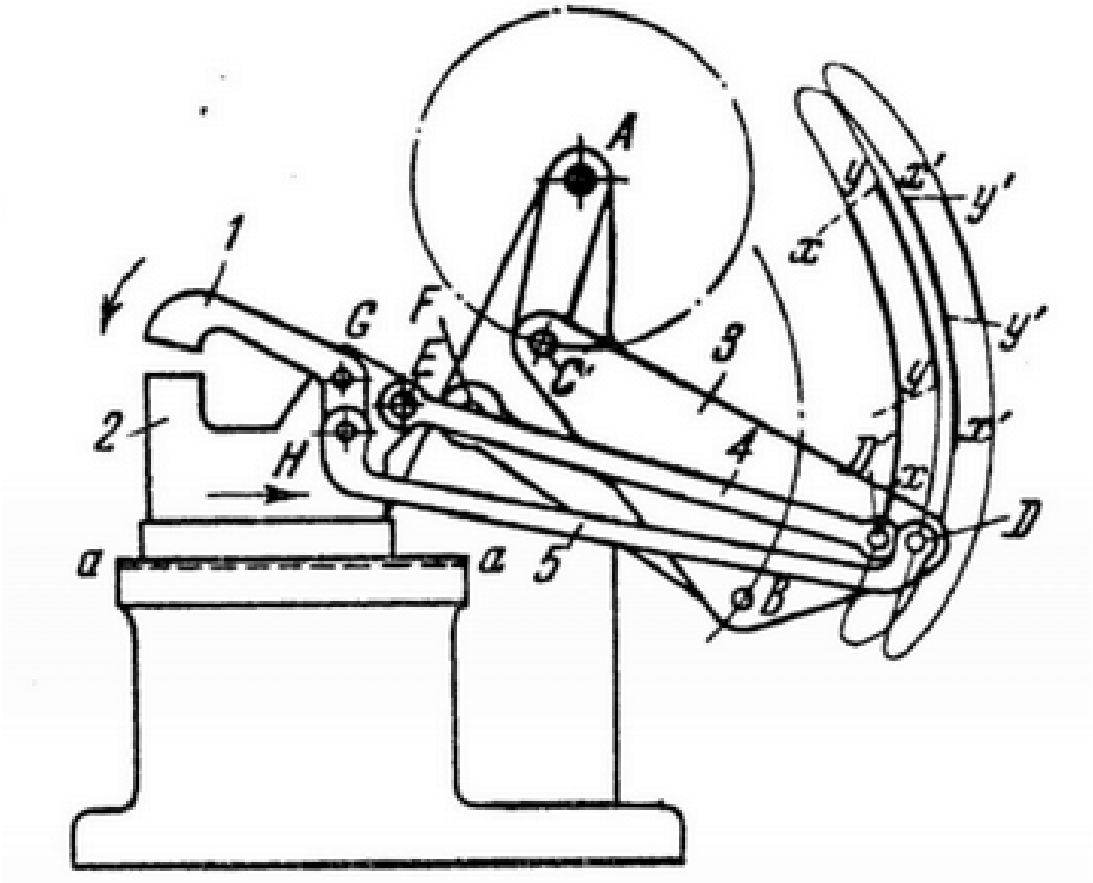


Figure 1: Mechanism number 4: Slider-crank gripping and feeding mechanism.

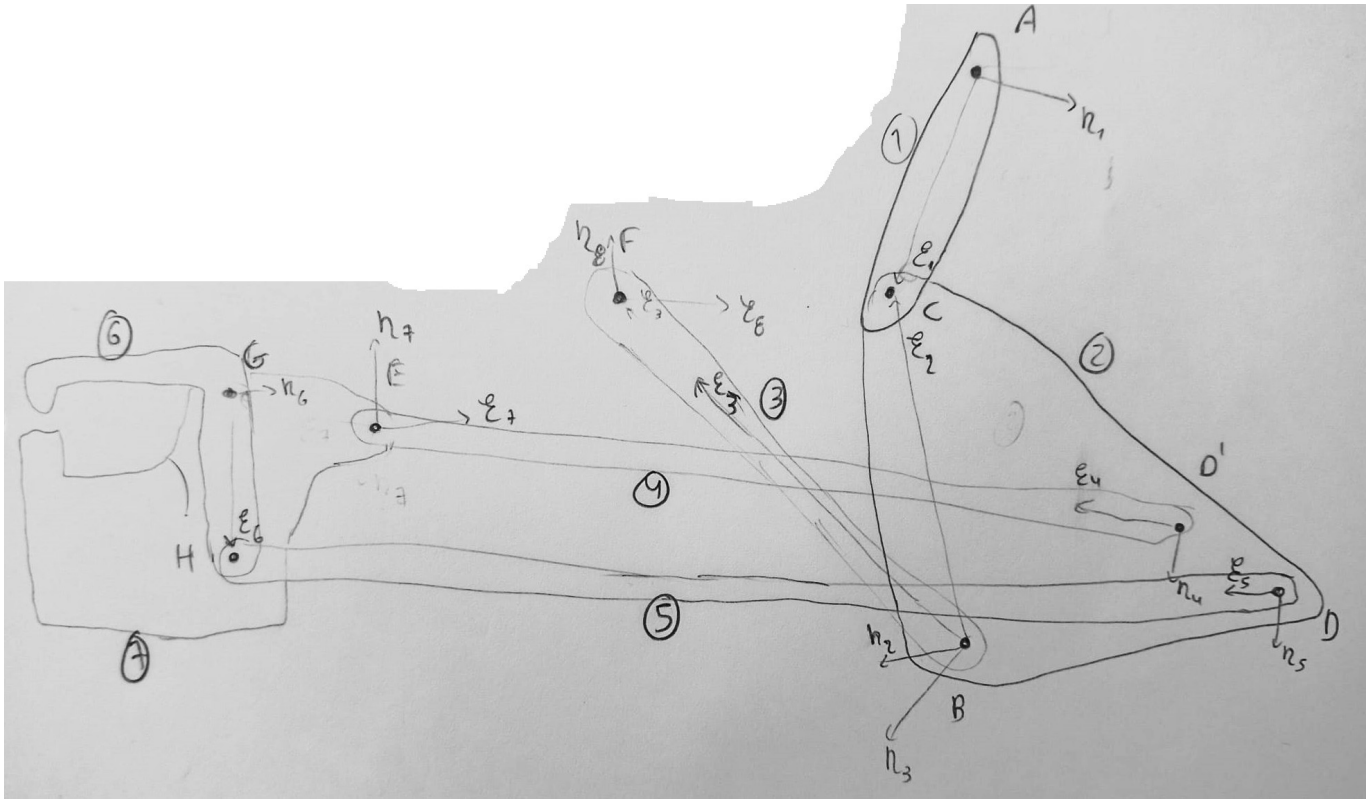


Figure 2: Drawing of the mechanism with the chosen bodies and respective body fixed coordinate systems. Body 8 is the ground and it's body fixed coordinate system coincides with the XY frame. All body fixed coordinate systems have their origin at joints and ξ axis aligned with link axis when possible

3 Initial positions and orientations

Body	x-coordinate (mm)	y-coordinate (mm)	θ (rad)
1	68	146	4.7
2	138.15	-144.62	1.6
3	138.15	-144.62	2.1
4	227.31	-132.43	2.3
5	248.15	-144.91	2.4
6	-71.19	24	4
7	-17.19	4	0.0
8	0.0	0.0	0.0

Table 1: Initial positions and orientations for all bodies

4 Input file for MUBOKAP (neatly organized in columns)

```
  8        9        0      0      0      0
 68      146      4.7
138.15  -144.62   1.6
138.15  -144.62   2.1
227.31  -132.43   2.3
248.15  -144.91   2.4
-71.19    24      4
-17.19     4      0
  0        0      0
  8        1     68    146     0      0
  1        2    100      0   200      0
  2        3      0      0     0      0
  2        4      0    -90     0      0
  2        5    -10   -115     0      0
  3        8    200      0     0      0
  4        7    280      0     0      0
  5        6    360      0    35      0
  7        6    -54     20     0      0
  7        2      4
  7        3      0
  8        1      0
  8        2      0
  8        3      0
  1        1      3      0   4.7   6.2832
  1      100      0
  2        0      0
  4        0      0
  5        0      0
  6        0      0
  6        0   -200
  7        0      0
  7     -254      0
  8        0      0
 12   0.0000001
  0     0.01      1
```

5 Trajectories of all relevant points & Variations of quantities in time

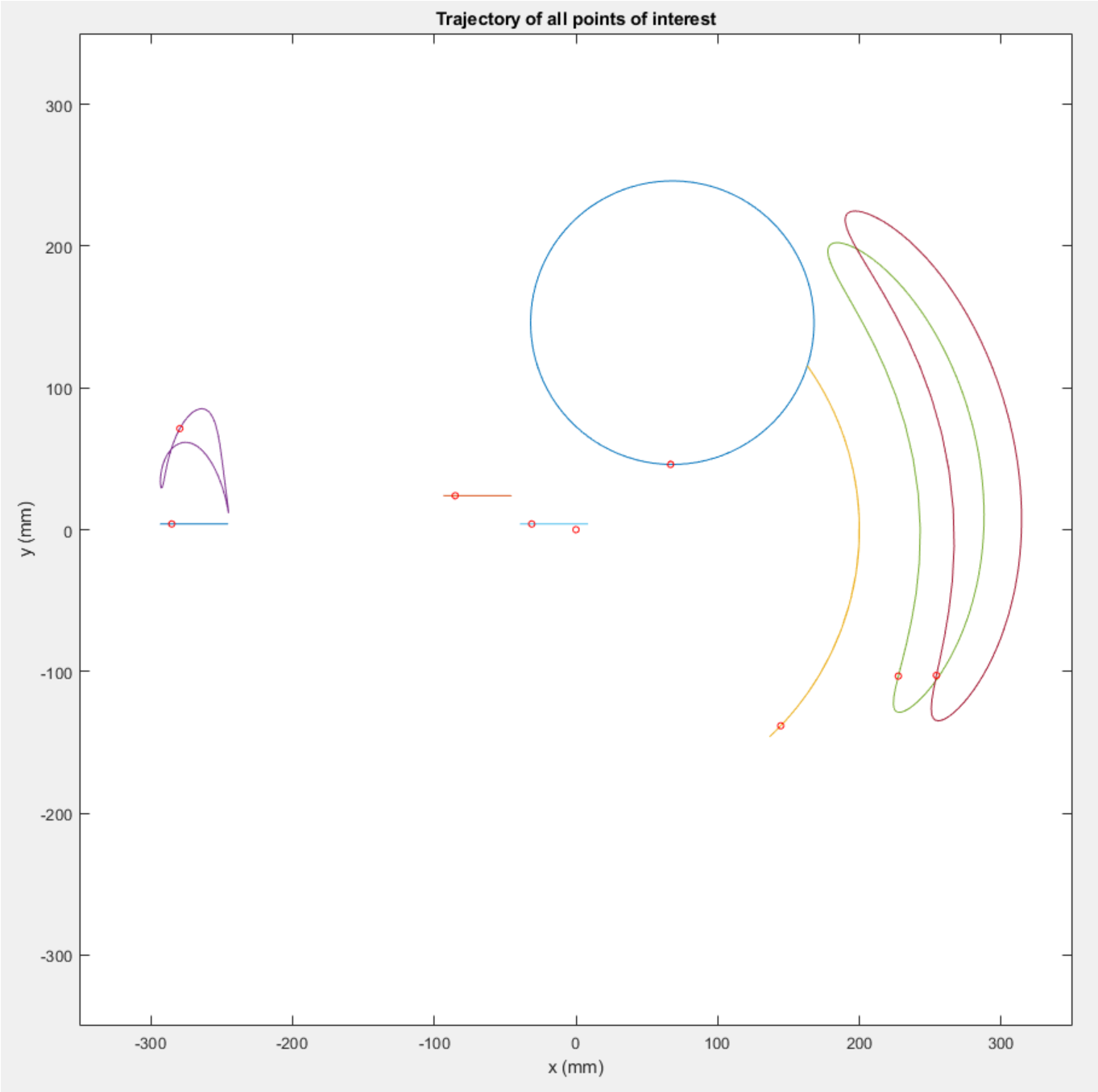
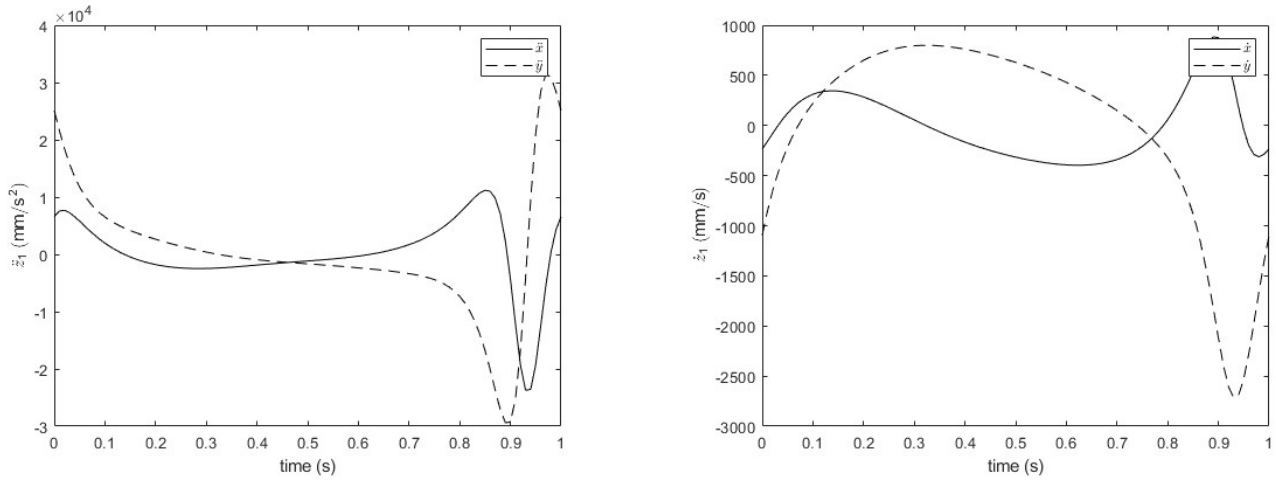


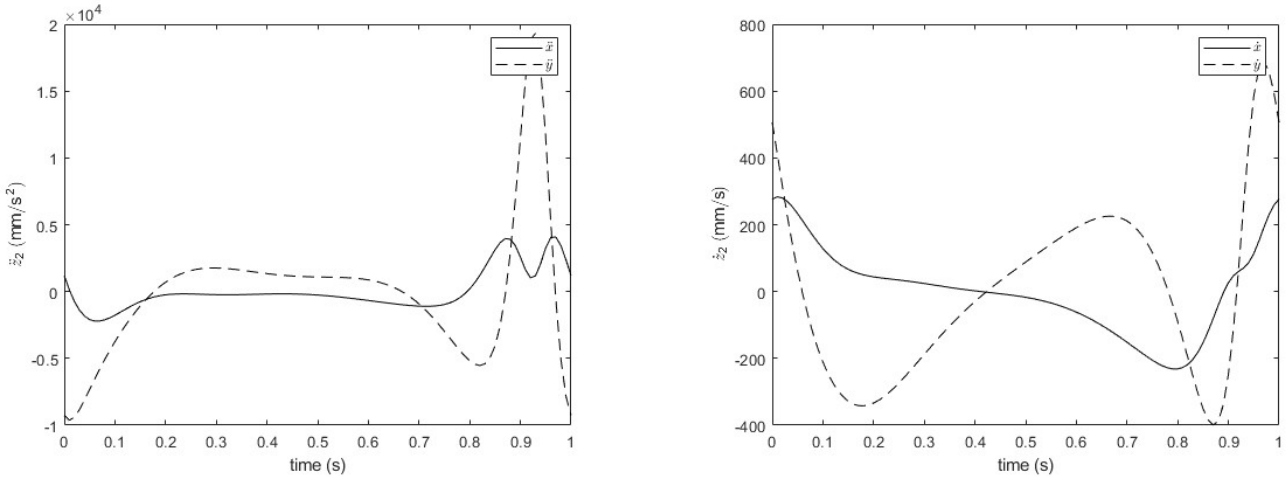
Figure 3: Trajectories of all relevant points. Point D is shown in magenta (right side of the image). Points on opposing faces of the gripper are shown in purple and light blue (left side of the image).



((a)) Acceleration in x and y versus time.

((b)) Velocity in x and y versus time.

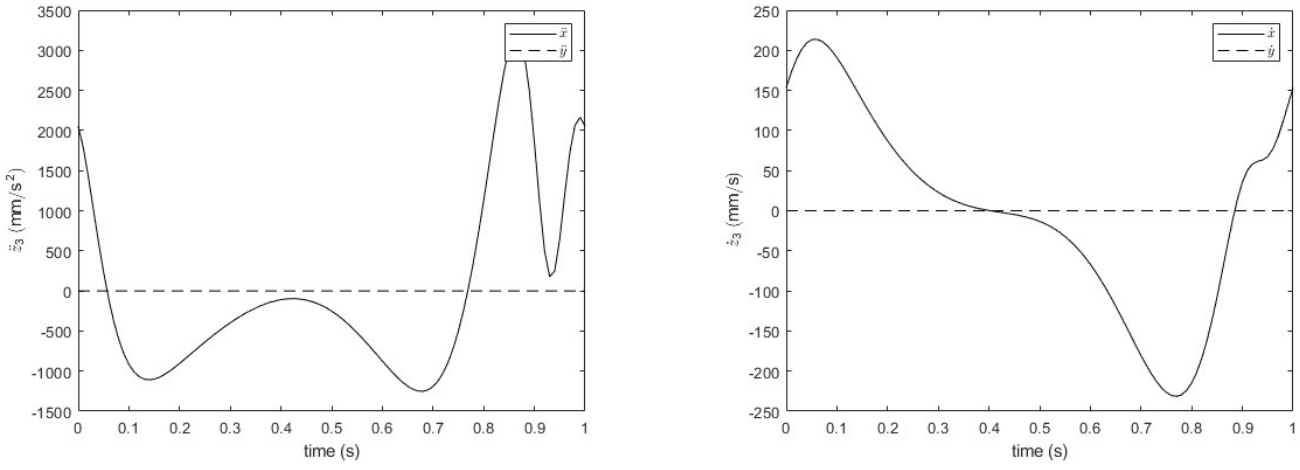
Figure 4: Acceleration and velocity over time for point D.



((a)) Acceleration in x and y versus time.

((b)) Velocity in x and y versus time.

Figure 5: Acceleration and velocity over time for point on the upper surface of the gripper.



((a)) Acceleration in x and y versus time.

((b)) Velocity in x and y versus time.

Figure 6: Acceleration and velocity over time for point on the lower surface of the gripper.