# Kinematics and Dynamics of Mechatronic Systems

## Exercise B3

## Geometrical model – workspace and motion path

For the selected kinematic structure of a manipulator the following tasks are to be completed.

## 1. The workspace

Taking into account the assumed joint motion ranges and dimensions of links present graphically the workspace of the modelled mechanism. The position should correspond to the tip of the third link.

## 2. The motion path

Plan 2 motion paths for the considered mechanism.
Depending on the type of the analyzed mechanism the listed below task should be completed. Planning a path comprises selection of the set of points in the workspace followed by solving the inverse kinematics with use of the procedure prepared during exercise B2 for each point.

**CASE A** of the spatial (3D) manipulator composed of 4 links, the last rotation axis is perpendicular to the last link.
TASK A: plan 2 paths corresponding to a manipulating operation: grasping of an object, lifting, fast motion, approach with slow down and releasing the object.
The paths should be composed of 10 points.
One path should be considerably longer that the other.
Present the paths in the workspace by a (broken) line.

**CASE B** of the spatial (3D) manipulator composed of 4 links, the last rotation axis is the longitudinal axis of the last link.
TASK B: plan 2 paths, one a straight line segment and one a segment of a circle. The paths should contain 10 points.
Present the paths in the workspace by a (broken) line.

**CASE C** of the planar mechanism composed of 3 links
TASK C: plan the 2 motion paths composed of at least 8 points lying on:
- a circle segment,
- connected straight line segments,

and show the paths on the workspace plot by (broken) lines
First, select the points of each path. Solve the inverse kinematic problem for these points using the formulas derived during the B2 exercise. For each point there might be an infinite number of solutions. Choose the solution with the selected axis of the coordinate frame assigned to the last link being perpendicular to each segment of the straight line, or tangential to the circle segment.
Next, present plots of the 3 joint motion paths (broken lines) for each path. You can smooth the paths by slight modification of the assumed values of the rotational joint variable

<u>The report should contain</u>:
- graphical presentation of the workspace and the paths in the Cartesian space
- graphical presentation of all joint motion paths (joint coordinates)
- list of the coordinates of the points of the Cartesian path (a table)
- list of the coordinates of all joint paths (a table)
- conclusions