

## **Geometrical model of a manipulator:** numerical analysis, motion path

### Schedule of the project class

- 1.A. Chose values of all joint variables (different than the multiples of  $\pi/2$  in case of rotary joints) and substitute them to the matrix  ${}^0\mathbf{T}_e$
- 1.B. Present graphically the manipulator in the selected setting (configuration). Indicate: joint variables, constant parameters and position of the end-effector on the picture. Prove that the geometrical model was formulated correctly:  $x$ ,  $y$ , and  $z$  coordinates are consistent with values obtained by substitution of joint variables' values to appropriate expressions.
2. Present graphically the vertical and the horizontal cross-section of the workspace of the manipulator's arm (the tip of the 3<sup>rd</sup> link)
- 3.A. For each joint variable a joint path, composed of approximately 10 values, should be constructed. Present graphs of all the joint variables as broken lines.
- 3.B. The forward kinematics procedure should be used to evaluate corresponding positions of the end-effector in the 3D space.
- 3.C. After assessment of regularity of the 3D path, it should be smoothed by modification of the joint paths.
- 3.D. The final joint paths and the corresponding 3D (Cartesian) path should be presented graphically in the report.

The report concerning tasks 1-3 should be sent by e-mail to the tutor not later than 24 hours before the next class in a single pdf file.