

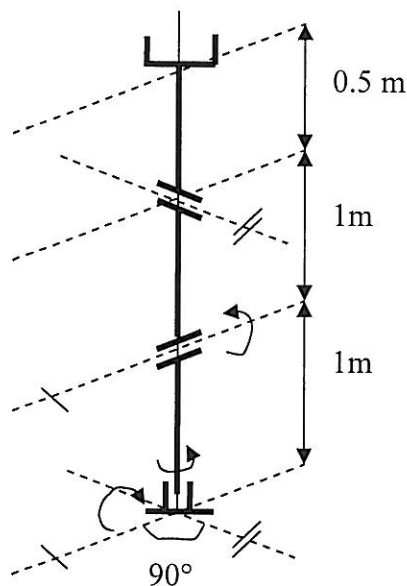
AS-84.3140 Robot Algorithms

1. Coordinate system B rotates around an instantaneous axis expressed in coordinate system A. Position vector BQ moves with constant velocity in B. What is its velocity in coordinate system A? How this formula is utilized in the derivation of the recursive equations of motion?

15 pt.

2. What relations can be drawn between equivalent angle-axis representation and the Euler parameters?

15 pt.



3. Calculate the velocity of the tip of the robot arm - shown on the figure - as a function of joint rates.

40 pt.

4. Give particular examples, when the multiplication of the homogeneous transformation matrices commutes. Explain their geometrical interpretation.

15 pt.

5. Elaborate on the robot mechanism singularity and its algorithmical treatment.

15 pt.

The formula (3.6) in the textbook Craig. Introduction to Robotics. 3rd ed. is

$${}^{i-1}T_i = \begin{bmatrix} c\theta_i & -s\theta_i & 0 & a_{i-1} \\ s\theta_i c\alpha_{i-1} & c\theta_i c\alpha_{i-1} & -s\alpha_{i-1} & -s\alpha_{i-1} d_i \\ s\theta_i s\alpha_{i-1} & c\theta_i s\alpha_{i-1} & c\alpha_{i-1} & c\alpha_{i-1} d_i \\ 0 & 0 & 0 & 1 \end{bmatrix}$$