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ME 4K03 TEST 1

Q1

1. End effector: the part of the robot that interacts with the environment attached to the last joint of the robot.

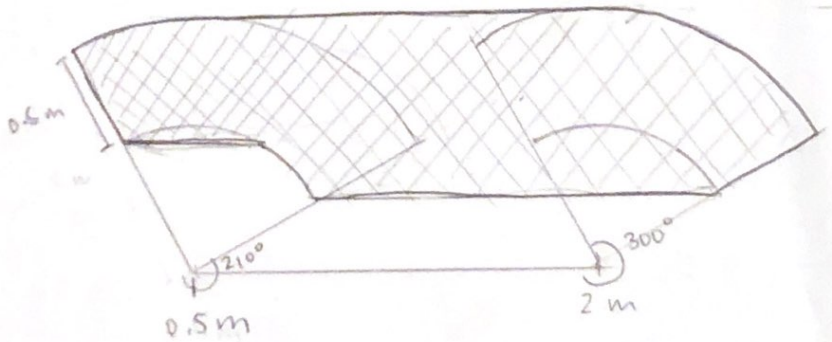
2. Repeatability: precision - how well the robot can be positioned in the same place repeatedly

3. Dextrous workspace: the volume of space the end-effector can reach with any orientation

4. Major axes: the first 3 joints of the robot.

Q2

0.5 m = 2 cm



Q3

a) let transformation matrix $T = I$

$T = Rot(60°, x) * Rot(Y, -45°) * I * Trans(2, -4, 5)$

$$T = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0.5 & -0.866 & 0 \\ 0 & 0.866 & 0.5 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 0.707 & 0 & -0.707 & 0 \\ 0 & 1 & 0 & 0 \\ 0.707 & 0 & 0.707 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & -4 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} 0.707 & 0 & -0.707 & -2.12 \\ -0.612 & 0.5 & -0.612 & -6.28 \\ 0.353 & 0.866 & 0.353 & -0.99 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

b) we have $T = Rot(60, x) * Rot(Y, -45) * I * Trans(2, -4, 5)$

we want $T = Rot(Y, -45) * I * Trans(2, -4, 5) * X$

$Trans(2, -4, 5)^{-1} * Rot(Y, -45)^{-1} * T = X$

So we have:

$T = Rot(Y, -45°) * I * Trans(2, -4, 5) * \underbrace{Trans(2, -4, 5)^{-1} * Rot(Y, -45)^{-1} * T}$

transformation matrix relative to current frame in step 3