SKA203 Assignment 1

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I. Introduction

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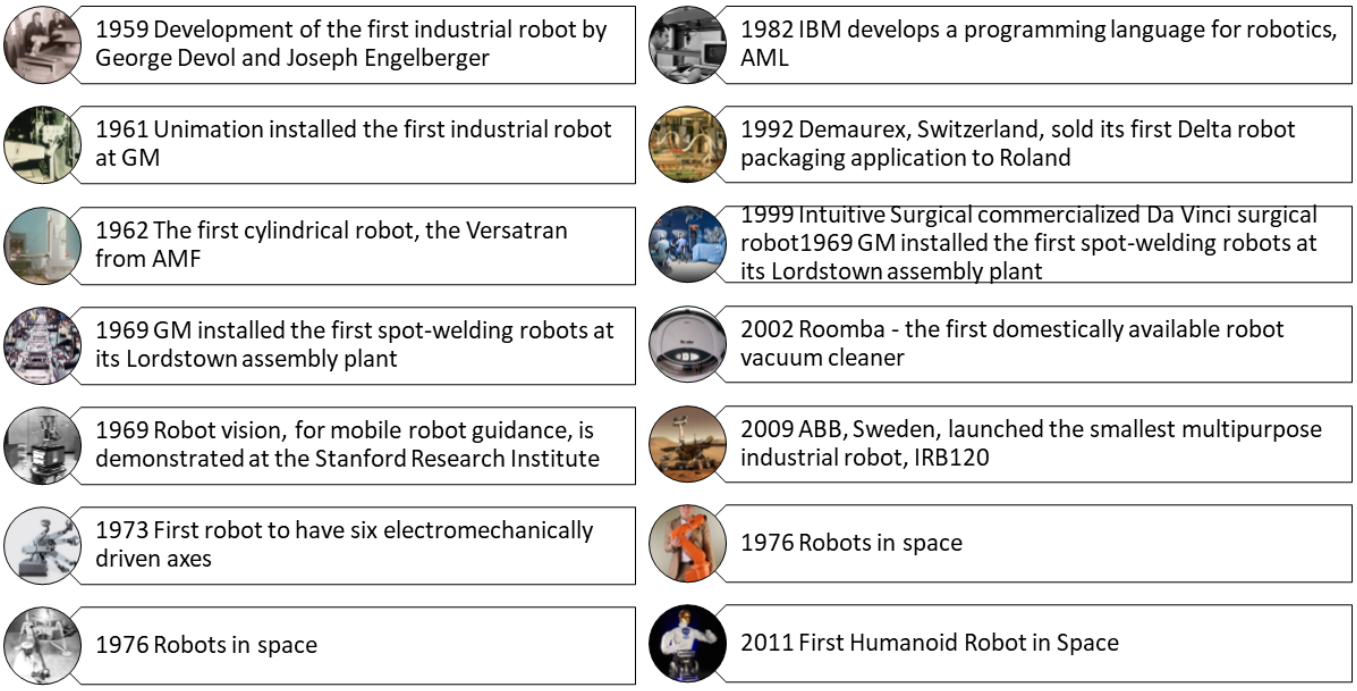

Fig. 1: The major events of industrial robot [1] [2]

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II. Homogeneous transformation: Question A

A. Problem (a)

Using the $Z-Y-X(\alpha-\beta-\gamma)$ Euler angle convention, the rotation matrix can be calculated as [3]

$$ {}^{A}_{B}R_{Z'Y'X'}(\alpha,\beta,\gamma) = R_Z(\alpha)\cdot R_Y(\beta)\cdot R_X(\gamma) \tag{1} $$

where

$$ R_X(\gamma)=\begin{bmatrix}1 & 0 & 0\\ 0 & \cos(\gamma) & -\sin(\gamma)\\ 0 & \sin(\gamma) & \cos(\gamma)\end{bmatrix} \quad R_Y(\beta)=\begin{bmatrix}\cos(\beta) & 0 & \sin(\beta)\\ 0 & 1 & 0\\ -\sin(\beta) & 0 & \cos(\beta)\end{bmatrix} \quad R_Z(\alpha)=\begin{bmatrix}\cos(\alpha) & -\sin(\alpha) & 0\\ \sin(\alpha) & \cos(\alpha) & 0\\ 0 & 0 & 1\end{bmatrix} \tag{2} $$

Then, the MATLAB code used to achieve is shown below

```
function [rot] = euler2rot(alpha, beta, gamma)

R_X = [1 0 0;
0 cos(deg2rad(gamma)) -sin(deg2rad(gamma));
0 sin(deg2rad(gamma)) cos(deg2rad(gamma))];

R_Y = [cos(deg2rad(beta)) 0 sin(deg2rad(beta));
0 1 0;
-sin(deg2rad(beta)) 0 cos(deg2rad(beta))];

R_Z = [cos(deg2rad(alpha)) -sin(deg2rad(alpha)) 0;
sin(deg2rad(alpha)) cos(deg2rad(alpha)) 0;
0 0 1];

rot = R_Z * R_Y * R_X;

end
```

References

[1] I. I. F. of Robotics, "Robot history." https://ifr.org/robot-history, 2021. accessed on September 28, 2022.

[2] V. McMorris, "A timeline history of robotics." https://futura-automation.com/2019/05/15/a-history-timeline-of-industrial-robotics/, 2021. accessed on September 28, 2022.

[3] J. J. Craig, *Introduction to robotics: mechanics and control*. Pearson Educacion, 2005.