My Karpled Sduff for ze ropodica armz brochect

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1 Raw Python

1.1 The Torques Applied onto the Wrist Joint

```
Tr_W = (M_W * 9.81) * L_W
```

1.2 The Torques Applied onto the Elbow Joint

```
Tr_E = ((M_W * 9.81) * (math.sqrt(L_W^2 +L_E^2 -(((2) * (L_W) *
 (L_E)) * (math.cos(A_W))))))+ ((M_E * 9.81) * L_E)
```

1.3 The Torques Applied onto the Shoulder Joint

```
Tr_S = (M_W * 9.81) * (math.sqrt((math.sqrt(L_W^2 +L_E^2 -(((2)
* (L_W) * (L_E)) * (math.cos(A_W)))))^2 +L_S^2 -(((2) * ((math.
sqrt(L_W^2 +L_E^2 -(((2) * (L_W) * (L_E)) * (math.cos(A_W)))))
* (L_S)) * (math.cos((A_E -(math.acos(((math.sqrt(L_W^2 +L_E^2 -
(((2)* (L_W) * (L_E)) * (math.cos(A_W)))))^2 +L_E^2 - L_W^2)/((2
)((math.sqrt(L_W^2 +L_E^2 -(((2)* (L_W) * (L_E)) * (math.cos(A_W
))))))(L_E))))))))))+((M_E *9.81) * (math.sqrt(L_E^2 +L_S^2 -(((
2) * (L_E) * (L_S)) * (math.cos(A_E))))))+ ((M_S * 9.81) * L_S)
```

2 Formulae

2.1 The Torques Applied onto the Wrist Joint

$$Tr_W = (9.81 \times M_W) \times L_W \tag{1}$$

2.2 The Torques Applied onto the Elbow Joint

$$Tr_E = ((9.81 \times M_W) \times \sqrt{{L_W}^2 + {L_E}^2 - (2 \times L_W \times L_E \times \cos(A_W))}) + (9.81 \times M_E \times L_E) \tag{2}$$

2.3 The Torques Applied onto the Shoulder Joint

$$Tr_S = ((9.81 \times M_W) \times R_{WS}) + ((9.81 \times M_E) \times R_{WE}) + ((9.81 \times M_S) \times R_S) \tag{3}$$

$$R_{WS} = \sqrt{{R_{WE}}^2 + {L_S}^2 - (2 \times R_{WE} \times L_S \times \cos(A_{E2})} \tag{4}$$

$$R_{WE} = \sqrt{{L_W}^2 + {L_E}^2 - (2 \times L_W \times L_E \times \cos(A_W))} \tag{5}$$

$$A_{E1} = \arccos(\frac{{R_{WE}}^2 + {L_E}^2 - {L_W}^2}{2 \times R_{WE} \times L_E}) \tag{6}$$

$$A_{E2} = A_E - A_{E1} \tag{7}$$

2.4 zo zad

yez Im zorry, no I didn't chust vrite this, I Hacdually coted/brogrammed it in LaTeX

3 Inverse Kinematics for Robotic Arm

3.1 Inverse Kinematics Modelling in Octave

Lengths:

$$L1 = 10 \text{ Length Of First Arm}$$
$$L2 = 7 \text{ Length of Second arm}$$
$$L3 = 4 \text{ Length of Third arm}$$

All possible θ values:

$$\theta 1 = 0 : 0.1 : \pi \text{ all possible theta1 values}$$
$$\theta 2 = 0 : 0.1 : 1.5 * \pi \text{ all possible theta2 values}$$
$$\theta 3 = 0 : 0.1 : \pi/2 \text{ all possible theta3 values}$$

Meshgrid:

$$[\theta 1,\ \theta 2,\ \theta 3] = \text{meshgrid}$$
$$(\theta 1, \theta 2,\ \theta 3) \text{ generate grid of angle values}$$

Compute Coordinates:

$$X = l1 * cos(\theta 1) + l2 * cos(\theta 1 + \theta 2) + l3 * cos(\theta 1 + \theta 2 + \theta 3) \text{ compute } x \text{ coordinates}$$
$$Y = l1 * sin(\theta 1) + l2 * sin(\theta 1 + \theta 2) + l3 * sin(\theta 1 + \theta 2 + \theta 3) \text{ compute } y \text{ coordinates}$$

Create datasets:

$$\text{data } 1 = [X(:)Y(:)\theta 1(:)] \text{ create } x\text{-}y\text{-}\theta 1 \text{ dataset}$$
$$\text{data } 2 = [X(:)Y(:)\theta 2(:)] \text{ create } x\text{-}y\text{-}\theta 2 \text{ dataset}$$
$$\text{data } 3 = [X(:)Y(:)\theta 3(:)] \text{ create } x\text{-}y\text{-}\theta 3 \text{ dataset}$$

Plot:

$$\text{plot}(X(:), Y(:),' r.')$$

Figure 1: $X - Y$ coordinates for all $\theta 1$, $\theta 2$, and $\theta 3$ combinations