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
```

!!Need To Redo/Update!!

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)
```

!!Need To Redo/Update!!

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)
```

!!Need To Redo/Update!!

2 Formulae

2.1 The Torques Applied onto the Wrist Joint

$$Tr_W = (9.81 \times M_W) \times (\frac{L_W}{2}) \tag{1}$$

2.2 The Torques Applied onto the Elbow Joint

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

2.3 The Torques Applied onto the Shoulder Joint

$$Tr_S = ((9.81 \times M_W) \times ((\frac{R_{WS} - R_{ES}}{2}) + R_{ES})) + ((9.81 \times M_E) \times ((\frac{R_{ES} - L_S}{2}) + R_{WE})) + ((9.81 \times M_S) \times (\frac{L_S}{2})) \tag{3}$$

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

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

$$R_{ES} = \sqrt{L_S^2 + L_E^2 - (2 \times L_S \times L_E \times \cos(A_E))} \tag{6}$$

$$A_{E1} = \cos^{-1}(\frac{{R_{WE}}^2 + {L_E}^2 - {L_W}^2}{2 \times R_{WE} \times L_E}) \tag{7}$$

$$A_{E2} = A_E - A_{E1} \tag{8}$$

3 Inverse Kinematics for Robotic Arm

3.1 Inverse Kinematics Modelling in Octave

Lengths:

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

All possible θ values:

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

Meshgrid:

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

Compute Coordinates:

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

Create datasets:

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

Plot:

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

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