CS422 Robotics and Automation Assignment 1

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Due 30th Sept. Late submissions will not be accepted

Read Textbook Chapter 2 and answer the following questions:

1. Use Grübler's formula to verify that the Stewart mechanism (Fig. 1) indeed has six degrees of freedom (10pts)

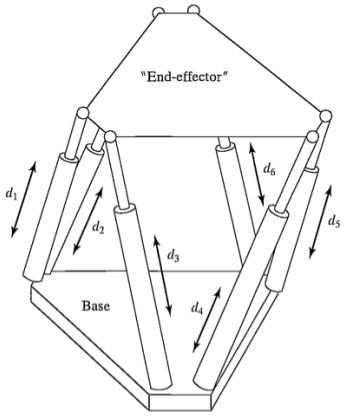

Figure 1: The Stewart mechanism is a six-degree-of-freedom fully parallel manipulator.

2. A vector P^A is rotated about $\hat{Z}_A$ by θ degrees and is subsequently rotated about $\hat{X}_A$ by ϕ degrees. Give the rotation matrix that accomplishes these rotations in the given order (5 pts).

3. A frame $\{B\}$ is located initialy coincident with a frame $\{A\}$. We rotate {B} about $\hat{Z}_B$ by θ degrees, and then we rotate the resulting frame about $\hat{X}_B$ by θ degrees. Give the rotation matrix that will change the descriptions of vectors from P^B to P^A (5pts)

4. Referring to Fig. 2

https://www.chegg.com/homework-help/questions-and-answers/1-given-equation-ap-borg-bc-get-value-bc-2-set-act-bct-cat-abt-value-matrix-form-get-rever-q58042240

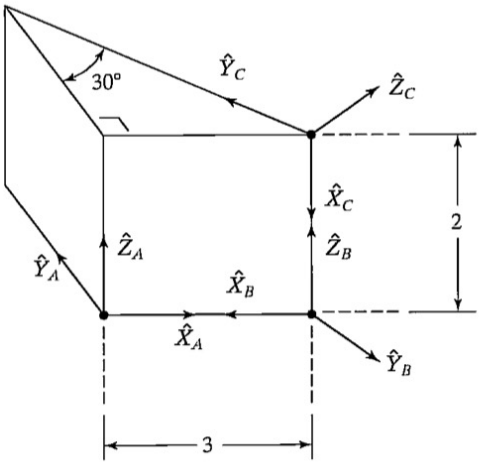

Figure 2: Frames at the corners of a wedge

(a) give the value of H_B^A
(b) give the value of H_C^A
(c) give the value of H_C^B
(d) give the value of H_A^C
(e) give the value of H_A^B (10pts)

5. Given

$$H_B^A = \begin{bmatrix} 0.25 & 0.43 & 0.86 & 5.0 \\ 0.87 & -0.50 & 0.00 & -4.0 \\ 0.43 & 0.75 & -0.50 & 3.0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

find H_A^B (5pts)

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0.2511    0.8638    0.4319    0.9040
0.4369   -0.4970    0.7515   -6.4271
0.8713   -0.0026   -0.5013   -2.8632
     0         0         0    1.0000
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