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Class: MECHANICS AND CONTROL OF ROBOT MANIPULATORS

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Home Work 1

1. A vector  is rotated about  by  degrees and is subsequently rotated about by  degrees
2. Give the rotation matrix which accomplishes these rotation in the given order.
3. What is the result if  and ?
4. A frame {B} is located as follow: Initially coincident with a frame {A} we rotate {B} about by  and then we rotate the resulting frame about by  degrees.
5. Give the rotation matrix,  which will change the description of vectors from to .
6. What is the result if  and ?
7. What is ?
8. A vector is given by



Given



Compute 

1. Given the following 3×3 matrix,



1. Show that it is a rotation matrix.
2. Determine a unit vector that defines this axis of rotation and the angle (in degree) of rotation.
3. What are the Euler parameters ε1, ε2, ε3, ε4 of R?

Solutions

1. a) Because  is rotated about  by  degrees and is subsequently rotated about by  degrees, the rotation matrix would be XZ fixed angle case, so:



b) If  and , the rotation matrix would be:



1. a) Frame {B} is rotated about by  and then we rotate the resulting frame about by  degrees. Therefore, this case must be Z-X Euler angles.

The rotation matrix  changing the description of vectors from to is as below:



b) If  and , the matrix  would be:



c) Because  so would be:



1. We have  so:



In conclusion: 

1. a)



If R is a rotation matrix, it will have following properties:



We have:



Inverse of matrix :



So R is a rotation matrix.

1. We call the unit vector that defines this axis rotation is , and the angle of rotation is.

We have:



And:



From , with Euler parameters, we have:

