Exercises#5

KINEMATICS AND DYNAMICS Course ID: 01416308

* Indicates required question

Sec No.? *

Your answer

Student ID (Member No.1) *

Your answer

Fullname (Member No.1) *

Your answer

1. Pls select the correct answer. *

Exercise A frame {A} is rotated 90° about x, and then it is translated a vector (6,-2,10) with respect to the fixed (initial) frame. Find the homogenous transformation matrix that describes {B} respect to {A}

a) $\begin{bmatrix} 1 & 0 & 0 & 6 \\ 0 & 0 & -1 & -2 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ c) $\begin{bmatrix} 1 & 0 & 0 & 6 \\ 0 & 0 & 1 & -2 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

b) $\begin{bmatrix} 1 & 0 & 0 & 6 \\ 0 & 0 & -1 & -2 \\ 0 & -1 & 0 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ d) $\begin{bmatrix} -1 & 0 & 0 & 6 \\ 0 & 0 & 1 & -2 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

- a)
- b)
- c)
- d)

2. Pls select the correct answer. *

Exercise Rotation about and translation along a global axis.

A point P is located at (0,0,200) in a body coordinate frame. If the rigid body rotates 30 deg./About the global X-axis and the origin of the body frame translates to (X,Y,Z) = (500, 0, 600), then the coordinates of the point in the global frame are :

a) $\begin{bmatrix} 500 \\ -100 \\ 773.2 \\ 0 \end{bmatrix}$ c) $\begin{bmatrix} 500 \\ 100 \\ 773.2 \\ 1 \end{bmatrix}$

b) $\begin{bmatrix} 500 \\ -100 \\ 773.2 \\ 1 \end{bmatrix}$ d) $\begin{bmatrix} 500 \\ -100 \\ 773.2 \end{bmatrix}$

- a)
- b)
- c)
- d)

3. Pls select the correct answer. *

Exercise Consider frame {A} and {B}. Point P in frame {B} is given by (5, 6, 7) find its coordinates with respect to frame {A} Using a homogeneous transformation matrix

a) $\begin{bmatrix} 2 \\ -1 \\ 7 \\ 0 \end{bmatrix}$ b) $\begin{bmatrix} 2 \\ 1 \\ 7 \\ 1 \end{bmatrix}$ c) $\begin{bmatrix} 2 \\ -1 \\ 7 \\ 1 \end{bmatrix}$ d) $\begin{bmatrix} 2 \\ -1 \\ 7 \\ 1 \end{bmatrix}$

- a)
- b)
- c)
- d)

4. Pls select the correct answer. *

Exercise A frame {A} is rotated 90° about x, and then it is translated a vector (6,-2,10) with respect to the fixed (initial) frame. Consider a point $\rho = (5,2,-15)$ with respect to the new frame {B}. Determine the coordinates of that point with respect to the initial frame

a) $\begin{bmatrix} 1 \\ 10 \\ 12 \\ 0 \end{bmatrix}$ b) $\begin{bmatrix} 1 \\ 10 \\ 12 \end{bmatrix}$ c) $\begin{bmatrix} 1 \\ 10 \\ 12 \\ 1 \end{bmatrix}$ d) $\begin{bmatrix} 1 \\ 0 \\ 12 \end{bmatrix}$

- a)
- b)
- c)
- d)

5. Pls upload the solution. *

Example Expressing the configuration of a frame relative to a space frame

If t = [1; 15;5]
$^{T}I_{B}$ = ?

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6. Pls upload the solution. *

Example Homogenous Transformation Matrix

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7. Pls upload the solution. *

Example Homogenous Transformation Matrix

The figure shows a robot whose base is 1m away from the base of the table. The table is 1m height and its surface is a square. Frame {1} is fixed on a corner of the table. A 20 cm cube is located on the middle of the table, and it has frame {2} attached to its center. A camera is located 2m above the table, just over the cube, and it has frame {3} attached to it.

a) Find the homogeneous transformations that relate each of these frames with the base system {0}

b) Find the homogeneous transformation that relates the cube frame {2} with respect to the camera frame {3} = ?

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Exercise A frame {A} is rotated 90° about x_A and then it is translated a vector (6,-2,10) with respect to the fixed (initial) frame. Find the homogenous transformation matrix that describes {B} respect to {A}

a) $\begin{bmatrix} 1 & 0 & 0 & 6 \\ 0 & 0 & -1 & -2 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ c) $\begin{bmatrix} 1 & 0 & 0 & 6 \\ 0 & 0 & 1 & -2 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

b) $\begin{bmatrix} 1 & 0 & 0 & 6 \\ 0 & 0 & -1 & -2 \\ 0 & -1 & 0 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ d) $\begin{bmatrix} -1 & 0 & 0 & 6 \\ 0 & 0 & 1 & -2 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

- a)
- b)
- c)
- d)

2. Pls select the correct answer. *

Exercise Rotation about and translation along a global axis.

A point P is located at (0,0,200) in a body coordinate frame. If the rigid body rotates 30 deg. About the global X-axis and the origin of the body frame translates to (X,Y,Z) = (500, 0, 600), then the coordinates of the point in the global frame are :

a) $\begin{bmatrix} 500 \\ -100 \\ 773.2 \\ 0 \end{bmatrix}$ c) $\begin{bmatrix} 500 \\ 100 \\ 773.2 \\ 1 \end{bmatrix}$

b) $\begin{bmatrix} 500 \\ -100 \\ 773.2 \\ 1 \end{bmatrix}$ d) $\begin{bmatrix} 500 \\ -100 \\ 773.2 \end{bmatrix}$

- a)
- b)
- c)
- d)

3. Pls select the correct answer. *

Exercise Consider frame {A} and {B}. Point P in frame {B} is given by (5, 6, 7) find its coordinates with respect to frame {A} using a homogeneous transformation matrix

a) $\begin{bmatrix} 2 \\ -1 \\ 7 \\ 0 \end{bmatrix}$ b) $\begin{bmatrix} 2 \\ 1 \\ 7 \\ 1 \end{bmatrix}$ c) $\begin{bmatrix} 2 \\ 1 \\ 7 \end{bmatrix}$ d) $\begin{bmatrix} 2 \\ -1 \\ 7 \end{bmatrix}$

- a)
- b)
- c)
- d)

4. Pls select the correct answer. *

Exercise A frame {A} is rotated 90° about x, and then it is translated a vector (6, -2, 10) with respect to the fixed (initial) frame. Consider a point p = (-5, 2, -12) with respect to the new frame {B}. Determine the coordinates of that point with respect to the initial frame

a) $\begin{bmatrix} 1 \\ 10 \\ 12 \\ 0 \end{bmatrix}$ b) $\begin{bmatrix} 1 \\ 10 \\ 12 \end{bmatrix}$ c) $\begin{bmatrix} 1 \\ 10 \\ 12 \\ 1 \end{bmatrix}$ d) $\begin{bmatrix} 1 \\ 0 \\ 12 \end{bmatrix}$

- a)
- b)
- c)
- d)

5. Pls upload the solution. *

Example Expressing the configuration of a frame relative to a space frame

If t = [1; 15;5]
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a) Find the homogeneous transformations that relate each of these frames with the base system {0}

b) Find the homogeneous transformation that relates the cube frame {2} with respect to the camera frame {3}

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1) ${}^0T_1 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

${}^0T_2 = \begin{bmatrix} 1 & 0 & 0 & -0.5 \\ 0 & 1 & 0 & 1.5 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

${}^0T_3 = R_y(180)\, R_z(90) \begin{bmatrix} -0.5 \\ 1.5 \\ 3 \\ 1 \end{bmatrix}$

$= \begin{bmatrix} 0 & 1 & 0 & -0.5 \\ 1 & 0 & 0 & 1.5 \\ 0 & 0 & -1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

2) ${}^3T_2 = {}^0T_2 \; {}^3T_0$

$= {}^0T_2 \cdot {}^0T_3^{-1}$

$= \begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$