ECE 470: Introduction to Robotics Homework 1

Question 1.

In Figure 1, Frame {A} and {B} are not connected.

a) Determine the transformation matrix ${}^{A}_{B}T_{1}$ after {B} rotates 45° about its axis X_B.

b) Determine the inverse matrix ${}^{A}_{B}T_{1}^{-1}$ in (a)

c) Determine the transformation matrix ${}^{A}_{B}T_{2}$ if new {B} revolve about Y_A.

d) Determine the transformation matrix ${}^{A}_{B}T_{3}$ if {A} rotates -90° about its X_A

(10 Points)

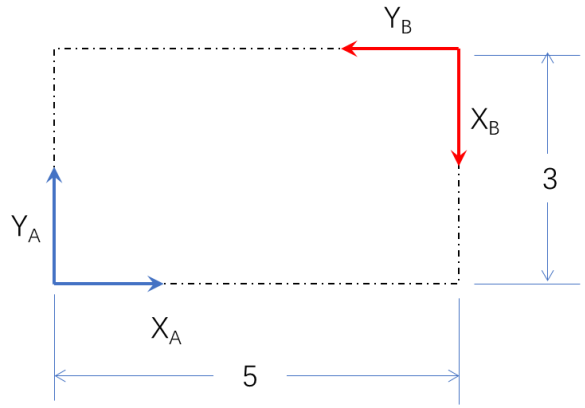


Figure 1

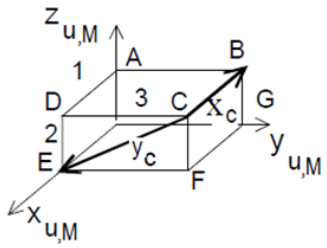
Question 2.

A cuboid with Frame {M} and Frame {C} attached rigidly is shown in Figure 2. The universe frame of reference {U} serves as an absolute frame that is always fixed. The cuboid motion is described by the series of transformation operations.

1> Rotation about the z axis of Frame C by 30°, then
2> Translation of (1, 2, 3) along Frame C, then
3> Rotation about the x axis of Frame M by 45°, and then
4> Rotation about the y axis of Frame U by 60°.

Let ${}^{U}T_{C_i}$ and ${}^{U}T_{M_i}$ be the 4 × 4 homogeneous transformation matrices that describes the position and orientation of Frames *C* and M, respectively, in *U* after motion *i*.

Find
i. ${}^{U}T_{C_1}$
ii. ${}^{U}T_{C_2}$
iii. ${}^{U}T_{C_3}$
iv. ${}^{U}T_{C_4}$
v. ${}^{U}T_{M_4}$



line segment lengths:
AD=1
DC=3
DE=2

Figure 2

(10 Points)