

**ECE 5397/6397: Intro to Robotics**

**Class Worksheet – Lecture 3: Rotation matrix & Homogenous Transforms**

1. What are three interpretations of a rotation matrix?
2. Write the matrix product that will give the resulting rotation matrix (do not perform the matrix multiplications:
   1. Rotate by *Φ* about the world *x*-axis
   2. Rotate by *θ* about the current *y*-axis
   3. Rotate by *ψ* about the world *z*-axis
3. Write the matrix product that will give the resulting rotation matrix (do not perform the matrix multiplications:
   1. Rotate by *Φ* about the world *x*-axis
   2. Rotate by *θ* about the current *z*-axis
   3. Rotate by *ψ* about the world *x*-axis
4. Write the matrix product that will give the resulting rotation matrix (do not perform the matrix multiplications:
   1. Rotate by *Φ* about the world *x*-axis
   2. Rotate by *θ* about the current *z*-axis
   3. Rotate by *ψ* about the current *x*-axis
   4. Rotate by *α* about the world *z*-axis

1. Suppose the three coordinate frames

, , and are given, and suppose

, . Find the matrix



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**Class Worksheet – Preparation for Lecture 4**

Consider the diagram at right. Robot is setup 1 meter from a table. The tabletop is 1 m high and 1 m square. A frame is fixed to the side of the table as shown. A cube measuring 20 cm on a side is placed in the center of the table with frame established at the center of the cube as shown. A camera is situated directly above the center of the block 2 meters above the table top with frame attached as shown.

1. Find the homogenous transform relating each of these frames to the base frame .
2. Find the homogenous transform relating the frame to the camera frame.

If the block on the table is rotated 90° about and moved so that its center has coordinates [0,0.8,0.1] relative to the frame ,

1. Compute the homogenous transform relating the block frame to the camera frame
2. Compute the homogenous transform relating the block frame to the base frame
3. Implement the swarmrobot outreach code at <http://www.cs.unm.edu/~elizabeth/mars_robots2.zip>. Set the numberOfRobots to 15, the recruitingRadius to 25, the number of singles to 60, and the number of clusters to 30. Click Setup and Go to run your program. Run the simulation 10 times. Make a note each time of how many ticks it took the robots to gather all the rocks. Take the average of those scores. You can find the tick counter at the top of the simulation window. Now run the simulation again 10 times, but with the recruiting radius turned down to 0. Make a note each time of how many ticks it took the robots to gather all the rocks. Take the average of those scores. Email file to TA.
4. Each team must perform a github checkin. Expect an email!