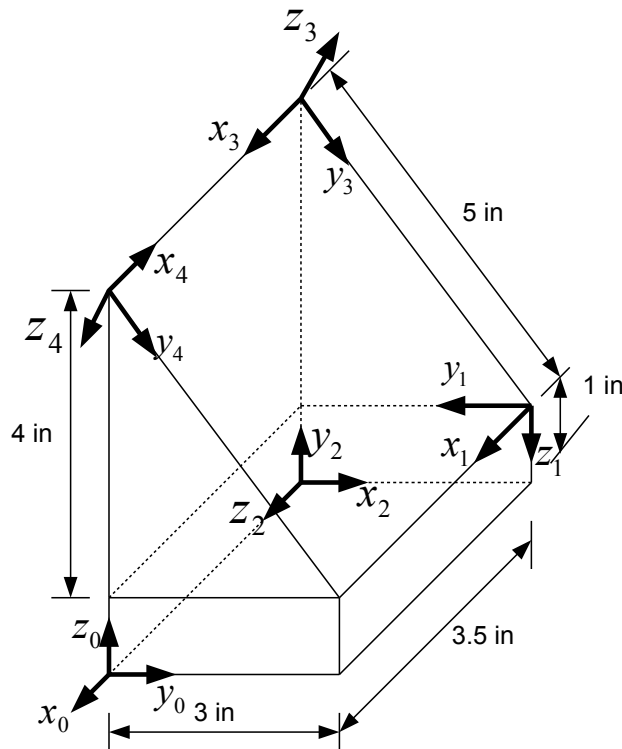


The City College of New York

EE/CS/CpE Joint Senior Design Program on
Smart Living and Assistive Technologies for People in Need
Instructors: Zhigang Zhu, Jizhong Xiao

Assignment #3

1. The robots are used because they can perform 4A job in 4D environment. What is 4A and 4D stand for? (8points)
2. What is the rotation matrix for a rotation of 30° about the OZ axis, followed by a rotation of 60° about the OX axis, followed by a rotation of 90° about the OY axis? (12 points)
3. For the figure shown below, find the 4×4 homogeneous transformation matrices ${}^{i-1}A_i$ and 0A_i for $i=1, 2, 3, 4$. (30 points)
Note: can you find the answer by observation based on the geometric interpretation of homogeneous transformation matrix?



4. What is the physical meaning of non-holonomic constraint? Among the five drive systems (differential drive, tricycle, synchronous, Ackerman Steering, omni-directional drive), which satisfy the non-holonomic constraint, which don't? (20 points)

5. How to determine the motor speed and direction using an optical incremental encoder? (20 points)

6. What is the Shannon's Sampling Theorem? (10 points)