

# RBE 501 Week 1 Assignment

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**Abstract**—This document provides an in-depth solution for Problem 2–37 described in Robot Modeling and Control. This is the assignment for the first week in RBE 501 (Robot Dynamics), Spring 2023 at Worcester Polytechnic Institute.

**Index Terms**—robotics, homogeneous transformation, frames

## I. INTRODUCTION

We are asked to solve Problem 2–37 of the main textbook [1]. Here, a robot is near a table, with a camera placed over the table to supervise the robot. A cube is also placed in the center of the table-top. The objective of the problem is to express all the frames in the environment (frame for the edge of the table, frame for the cube, and frame for the overhead camera) in terms of the homogeneous transformations with respect to the base frame, situated at the base link of the robot. An additional objective of the problem is to find the homogeneous transformation relating the center of the cube's frame to the camera's frame. The graphic below, given in the textbook, gives a pictorial representation of the problem.

## II. MATERIALS AND METHODS

We know from the textbook [1] that given a rotational matrix  $R$ , and a rigid translation  $d$ , we have the following definition of a homogeneous transformation,

$$H = \begin{bmatrix} R & d \\ 0 & 1 \end{bmatrix}; R \in SO(3), d \in \mathbb{R}^3$$

Also, the homogeneous transformation  $H_n^m$  describes the transformation of frame  $n$  with respect to  $m$ . Therefore, given our objectives, and the frames as numbered in Figure 1, we need to find  $H_1^0$ ,  $H_2^0$ ,  $H_3^0$ , and  $H_2^3$ .

## REFERENCES

- [1] M. W. Spong, S. Hutchinson, and M. Vidyasagar, "Robot modeling and control," 2006.

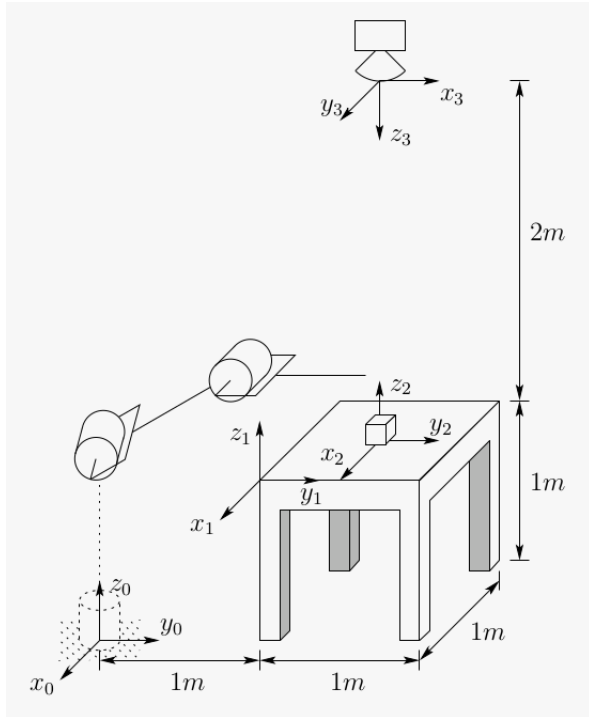


Fig. 1. Figure for 2–37