

Homework 1

EECE 5550

Andrew Tu

February 1, 2019

1 2

1.1 Visual of Workspace

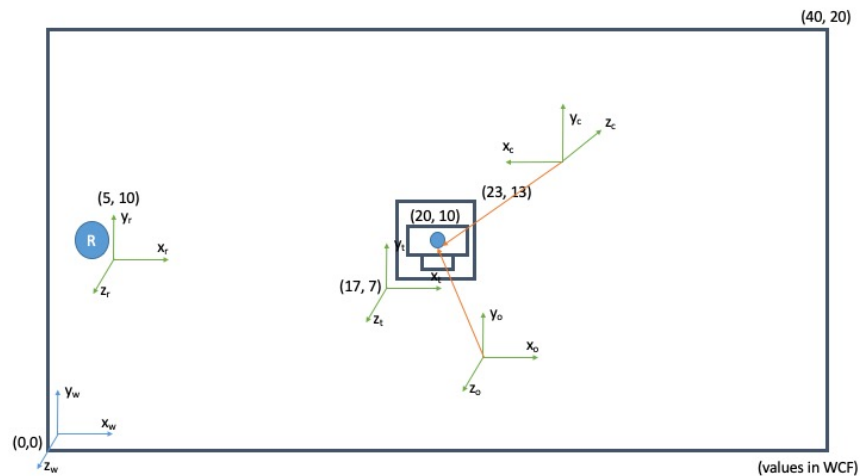


Figure 1: Top Down Image of Room.

1.2 Assign Coordinate Frames

See fig. 1. Assign the world, robot, camera, table, and object coordinate frames.

- world: origin at top left
- robot: origin at $(5, 10, 0)_{world}$
- camera: origin at $(20, 10, 10)_{world}$
- table: origin at $(23, 7, 3)_{world}$
- object: origin at $(20, 10, 3)_{world}$

1.3 Express Homogeneous Transforms

$$T_s^d = \begin{bmatrix} r_{11} & r_{21} & r_{31} & dx \\ r_{12} & r_{22} & r_{32} & dy \\ r_{13} & r_{23} & r_{33} & dz \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

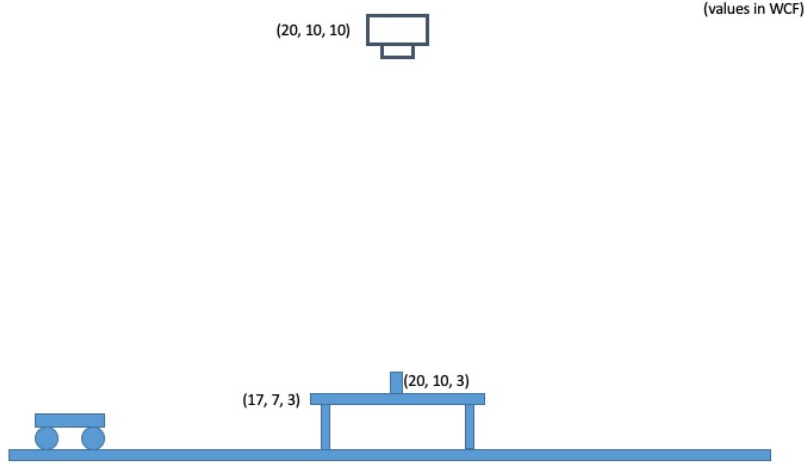


Figure 2: Side Image of Room.

1.3.1 Robot coordinate frame with respect to the world coordinate frame

$$T_r^w = \begin{bmatrix} 1 & 0 & 0 & 5 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

1.3.2 Table coordinate frame with respect to the world coordinate frame

$$T_t^w = \begin{bmatrix} 1 & 0 & 0 & 17 \\ 0 & 1 & 0 & 7 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

1.3.3 Camera coordinate frame with respect to the table coordinate frame

$$T_c^t = \begin{bmatrix} -1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & -1 & 7 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

1.3.4 Object coordinate frame with respect to the table coordinate frame

$$T_o^t = \begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

1.3.5 Object coordinate frame with respect to robot coordinate frame

$$T_o^r = \begin{bmatrix} 1 & 0 & 0 & 15 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

1.4 General Equation from Object in Robot Coordinate to rest of coordinate frames

$$p_o^r = \begin{bmatrix} 15 \\ 0 \\ 3 \\ 1 \end{bmatrix}$$

$$P_o^f = T_w^f * T_r^w * p_o^r$$

$\begin{matrix} 4 \times 4 & 4 \times 4 & 4 \times 1 \end{matrix}$

1.5 Experimentation

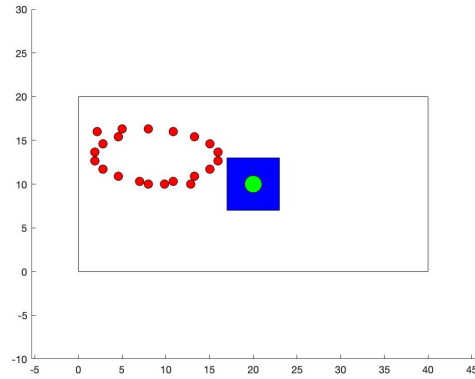


Figure 3: Experiments with Transition Matrix