
Instruction: Hand in this homework via email only.

Member:

1. Name: _____ Code: _____

Questions:

1. In Example 3.19 and Figure 3.16 of the book namely, *Modern Robotics: Mechanics, Planning, and Control*, the block that the robot must pick up weights 1 kg, which means that the robot must provide approximately 10 N of force in the \hat{z}_s -direction of the block's frame $\{e\}$ (which you can assume is at the block's center of mass). Express this force as a wrench \mathcal{F}_e in the $\{e\}$ frame. Given the transformation matrices in Example 3.19, express this same wrench in the end-effector frame $\{c\}$ as \mathcal{F}_c .

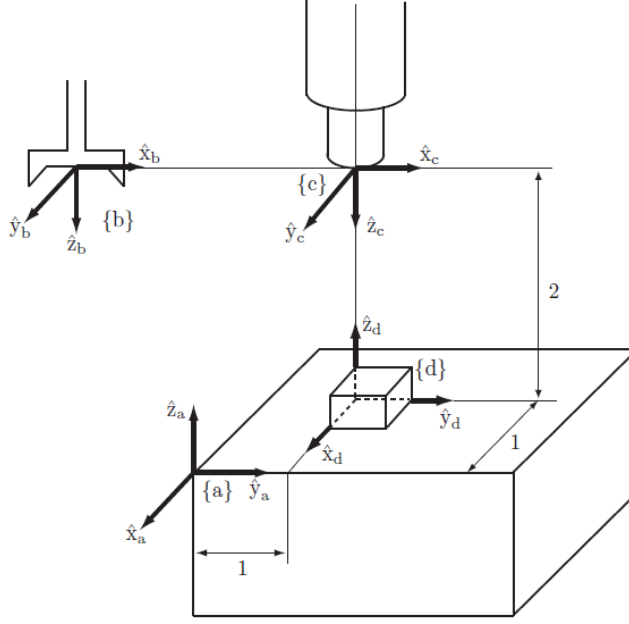


Figure 1: Four reference frames defined in a robot's workspace

2. Four reference frames are shown in the robot workspace of Figure 1: the fixed frame $\{a\}$, the end-effector frame $\{b\}$, the camera frame $\{c\}$, and the workpiece frame $\{d\}$.
 - Find aT_d and cT_d in terms of the dimensions given in the figure.
 - Find aT_b given that

$${}^bT_c = \begin{bmatrix} 1 & 0 & 0 & 4 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$