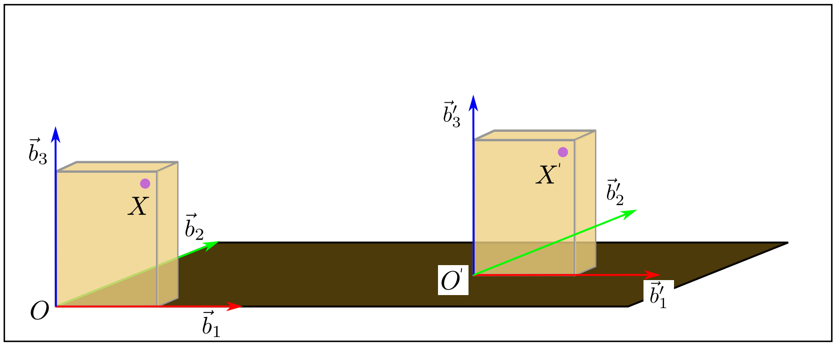
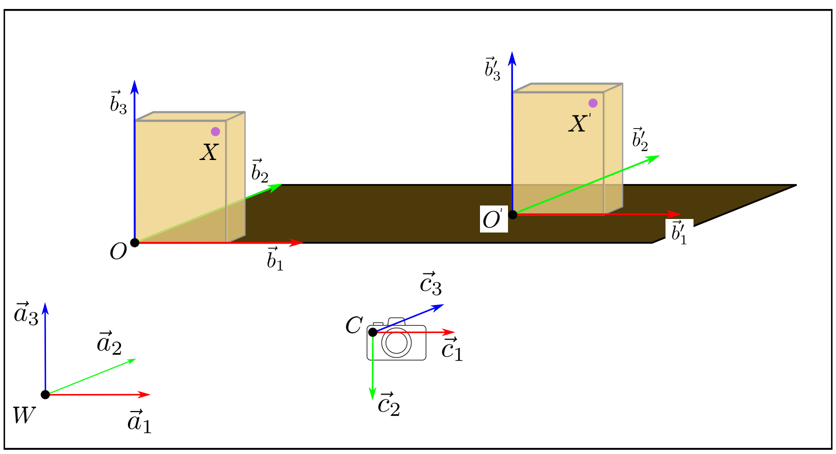


Task 1

In this task, we will study the effect of motion (rotation and translation) on a rigid body. We start with a cuboid body and a coordinate system (O, β) attached to it, where $\beta = [\vec{b}_1, \vec{b}_2, \vec{b}_3]$. We attach a marker at the point X of the body, this point can be expressed as a vector $\vec{x}_\beta$, with coordinates $\vec{x}_\beta = [1, 2, 3]^\top$. Now we apply the given motion on this rigid body (rotation R and translation t). This will result in a new coordinate system (O', β'), where $\beta' = [\vec{b}'_1, \vec{b}'_2, \vec{b}'_3]$.

Compute X'_β



Task 2

Next, we will study a task inspired by a real-world problem. In this task, we will move the body from a known (measured) pose to some new pose and capture this with a measuring device. We will assume that we have the ability to estimate a pose of the object with respect to the device. The task will be to recover the new pose of the object.

We create two more coordinate systems: the world coordinate system (W, α), where $\alpha = [\vec{a}_1, \vec{a}_2, \vec{a}_3]$ and the device coordinate system (C, γ), where $\gamma = [\vec{c}_1, \vec{c}_2, \vec{c}_3]$. The world coordinate system is fixed at a known location in space, and all other elements (object pose, robot end-effector pose) are expressed in this common coordinate system. The measuring device coordinate system (C, γ) is attached to the device and all the measurements are expressed in this coordinate system.

The transformation between the device coordinate system and world coordinate system is not known.

The transformation from the **world** coordinate system to body coordinate system before the motion $((O, \beta))$ is described by rotation R_1 and translation t_1.

The transformation from the **device** coordinate system to body coordinate system before the motion $((O, \beta))$ is described by rotation R_2 and translation t_2.

The transformation from the **device** coordinate system to body coordinate system after the motion $((O', \beta'))$ is described by rotation R_3 and translation t_3.

Compute the translation between **world** and the object after the motion, so $\vec{WO'}_\alpha$