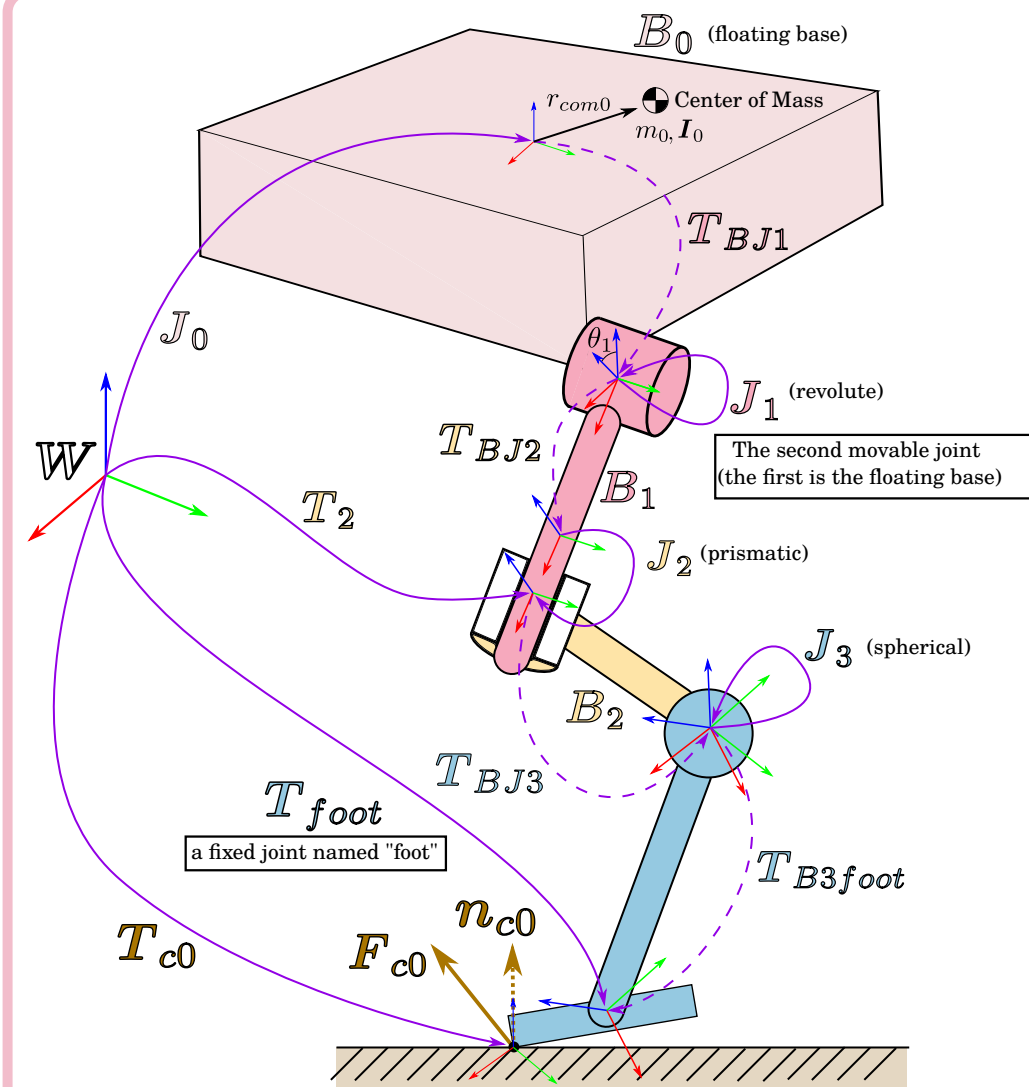


RaiSim Cheatsheet: Articulated system

by Jemin Hwangbo

floating-base system



Joint state representation

$$J_0 \quad \begin{aligned} \psi_0 &= r_0, q_0 \\ u_0 &= v_0, \omega_0^W \end{aligned}$$

Base position and quaternion

[angular velocity defined in the world frame!!!]

$$J_1 \quad \begin{aligned} \psi_1 &= \theta_1 \\ u_1 &= \dot{\theta}_1 \end{aligned}$$

$$J_2 \quad \begin{aligned} \psi_2 &= d_2 \\ u_2 &= \dot{d}_2 \end{aligned}$$

$$J_3 \quad \begin{aligned} \psi_3 &= q_3 \\ u_3 &= \omega_3 \end{aligned}$$

joint rotation relative to the parent, expressed in quaternion

angular velocity relative to the parent

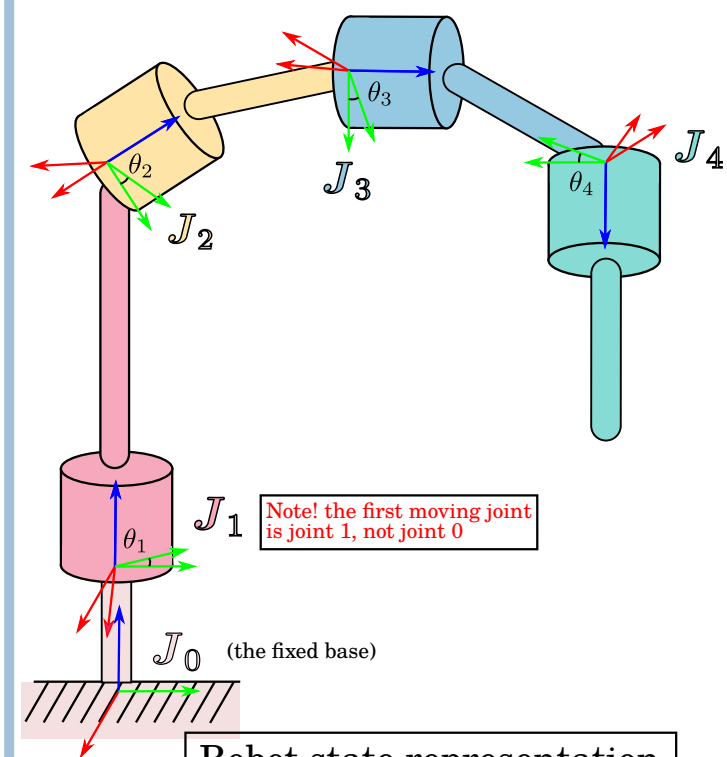
Robot state representation

$$\begin{aligned} \psi &= [r_0, q_0, \theta_1, d_2, q_3]^T \\ u &= [v_0, \omega_0, \dot{\theta}_1, \dot{d}_2, \omega_3]^T \end{aligned}$$

Legend

Varying transformation (a function of the generalized coordinate)
 Constant transformation (independent of the generalized coordinate)

fixed-base system



Robot state representation

$$\begin{aligned} \psi &= [\theta_1, \theta_2, \theta_3, \theta_4] \\ u &= [\dot{\theta}_1, \dot{\theta}_2, \dot{\theta}_3, \dot{\theta}_4] \end{aligned}$$

How to get ?

Transformations

T_{foot}

getFramePosition("foot", position_ref)
getFrameOrientation("foot", rotation_matrix_ref)

T_2

getPosition(2, position_ref)
getOrientation(2, rotation_matrix_ref)

B_1

Body doesn't have a frame of its own (by the URDF convention). It is attached to the associated joint frame

its derivatives

getFrameVelocity("foot", velocity_ref)
getFrameAngularVelocity("foot", ang_vel_ref)

getFrameVelocity(2, velocity_ref)
getFrameAngularVelocity(2, ang_vel_ref)

associated jacobians, that satisfy

getDenseFrameJacobian("foot", jaco_ref)
getDenseFrameRotationalJacobian("foot", jaco_ref)

$$\begin{aligned} v^W &= J_p u \\ \omega^W &= J_r u \end{aligned}$$

Call these methods with the joint name. All joints are converted to frames

Robot definition (non-const ref's)

T_{BJ2}

getJointPos_P() r_{com0} getLinkCOM()
getJointAxis_P() m_0 getMass()
getJointOrientation_P() I_0 getInertia()

Robot state

ψ

getGeneralizedCoordinate()

u

getGeneralizedVelocity()

Contacts (identical to single body methods)

n_{c0} (contact normal) getContacts()[0].getNormal()

T_{c0}

getContacts()[0].getPosition()
getContacts()[0].getContactFrame()

F_{c0}

getContacts()[0].impulse() / dt

'dt' can be obtained by
raisim::World::getTimeStep()

This contact impulse is defined in the contact frame. To get impulse/force in the world frame, premultiply it by the contact frame rotation matrix