

## Simulated Robotic Manipulation Protocol

Reference No / Version	RAL-SI-2020-P[19-0842]_1-V1.1 for the latest versions of the protocol please refer to <a href="https://research.csiro.au/robotics/manipulation-benchmark/">https://research.csiro.au/robotics/manipulation-benchmark/</a>
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Purpose	A task to replicate simple kinematic motion of a robotic manipulator. This will assess the movement of the arm without environmental interactions, the first step in assessing the ability of a simulator to represent a robotic manipulator.
Task Description	The task involves a short, 10 second, sequence of movements that begins with a single moving joint and will conclude in the movement of 3 joints simultaneously. A video of the task being performed by the real world manipulator is available at <a href="https://research.csiro.au/robotics/manipulation-benchmark/">https://research.csiro.au/robotics/manipulation-benchmark/</a>
Setup Description	<u>List of objects and their descriptions:</u> <ul style="list-style-type: none"> <li>Flat laminated surface</li> </ul>
	<u>Initial and target poses of the objects:</u> Nil
	<u>Description of the manipulation environment:</u> <ul style="list-style-type: none"> <li>Temperature: 21.3°C</li> <li>Relative Humidity: 32%</li> </ul>
Robot/Hardware/Software/Subject Description	<u>Targeted robots/hardware/software:</u> <ul style="list-style-type: none"> <li>Kinova Mico<sup>2</sup> 6DOF Manipulator, sensor mounting bracket, Robotiq FT300 sensor, gripper mounting bracket and KG-3 Gripper. URDF of robot provided.</li> </ul>
	<u>Initial state of the robot/hardware/subject with respect to the setup:</u> <ul style="list-style-type: none"> <li>Robot is fixed 0.055 meters above origin and the base centered.</li> <li>The base frame of the robot should align with the origin frame of the simulator as demonstrated in Figure 1 and Figure 2.</li> </ul> <div data-bbox="433 1459 1300 1927" data-label="Image"> </div>
<p><i>Figure 1: Side orthographic view of robot setup with offsets and reference frames.</i></p>	

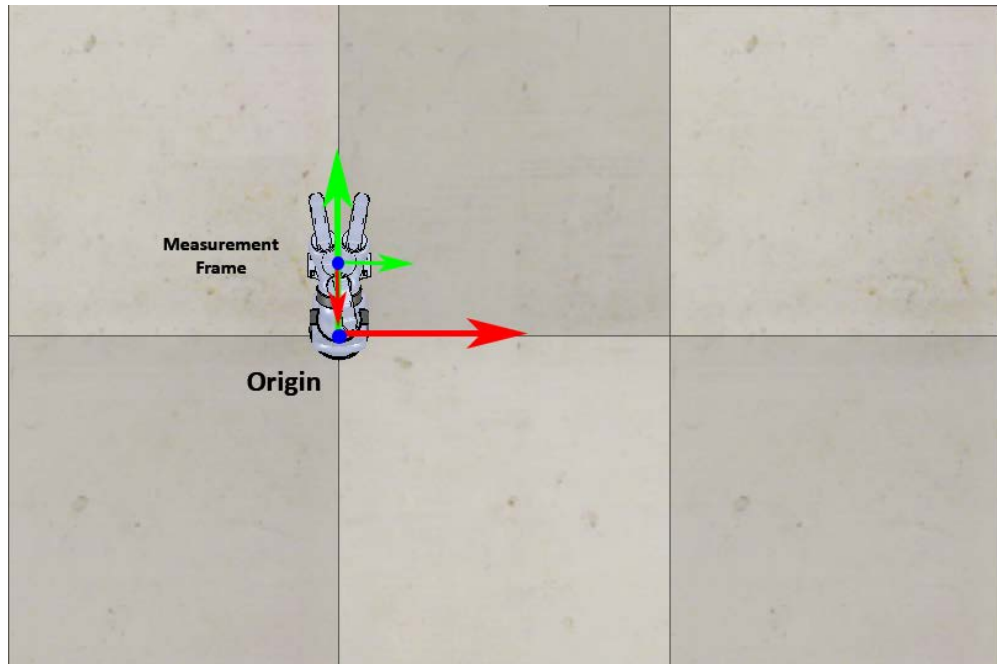


Figure 2: Top view of robot setup with offsets and reference frames.

- The robot begins with the following joint rotations (0,180,180,0,0,0)
- Gripper remains fully open.
- Control of the robot is at 10Hz using a Proportional controller to set joint velocities.
  - The gain of the P controller is 4
  - The controller requires the current joint rotations from the robot.

Prior information provided to the robot:

Nil

#### Procedure

The following is a sequence of rotations and times the robot has to achieve the desired configurations. The proportional controller is supplied with this information to elicit the desired movements of the manipulator.

0. (0,180,180,0,0,0) at start
1. (0,90,180,0,0,0) for 3 seconds
2. (0,180,270,0,0,0) for 3 seconds
3. (0,90,180,0,90,0) for 4 seconds

#### Execution Constraints

- The configuration of the robot and the proportional velocity controller are fixed parameters that are not user definable.