

FEDERAL STATE AUTONOMOUS EDUCATIONAL INSTITUTION OF HIGHER
EDUCATION
NATIONAL RESEARCH UNIVERSITY ITMO
ITMO UNIVERSITY

FACULTY OF CONTROL SYSTEMS AND ROBOTICS

PROGRAM:
ROBOTICS AND ARTIFICIAL INTELLIGENCE

LABORATORY REPORT
SIMULATION OF ROBOTIC SYSTEMS
PRACTICAL WORK №3

STUDENT
Zongo Sabane

PROFESSOR
Rakshin Egor Aleksandrovich

Academic Year: 2025

This report presents the development of a simulation model for a robotic mechanism, implemented in Mujoco using provided geometric parameters. The model represents a three-branch articulated system constrained to meet at a common point.

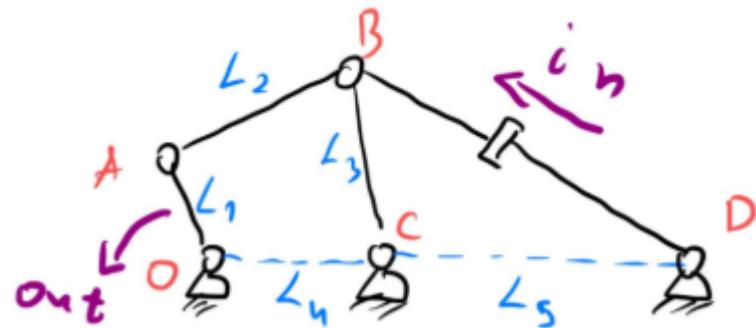
STATEMENT

This task involves developing a Python script that integrates model, data, and viewer based on the parameters provided, and then executing the simulation.

parameters:

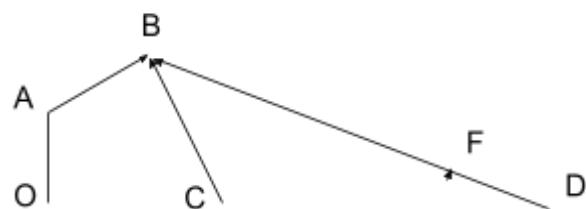
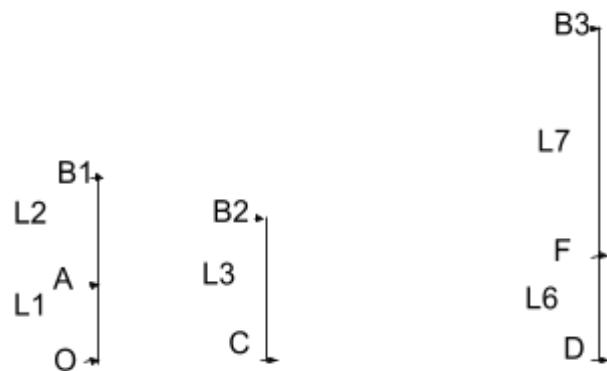
L1, m	L2, m	L3, m	L4, m	L5, m
0.072	0.0936	0.108	0.072	0.36

Variant 2 - Optimus' knee closed-chain mechanism:



SOLVING

The figures below represent the detailed diagram of our mechanism.



Optimus' knee closed chain mechanism

Lengths:

L1, m	L2, m	L3, m	L6, m	L7, m
0.072	0.0936	0.108	0.072	0.36

I. SCRIPT

```
import mujoco
import mujoco.viewer
import time

xml = """


<mujoco>
    <option timestep="0.001"/>
    <option gravity="0 0 -9.8"/>

    <asset>
        <texture type="skybox" builtin="gradient" rgb1="1 1 1" rgb2="0.5
0.5 0.5" width="265" height="256"/>
        <texture name="grid" type="2d" builtin="checker" rgb1="0.1 0.1 0.1
rgb2="0.6 0.6 0.6" width="300" height="300"/>
        <material name="grid" texture="grid" texrepeat="10 10"
reflectance="0.2"/>
    </asset>

    <worldbody>
        <light pos="0 0 10"/>
        <geom type="plane" size="0.5 0.5 0.1" material="grid"/>

        <!-- Branch 1: L1 + L2 -->
        <body name="OAB1" pos="0 0 0.5">
            <joint name="O" type="hinge" axis="0 -1 0" stiffness="0"
damping="0"/>
            <geom name="point O" type="cylinder" pos="0 0 0" size="0.005
0.005" rgba="0.89 0.14 0.16 0.5" euler="0 0 0" contype="0"/>
            <geom name="link_OA" type="cylinder" pos="0 0 0.036" size="0.005
0.036" rgba="0.2 0.4 0.9 0.7"/>
            <body name="AB1" pos="0 0 0.072">
                <joint name="A" type="hinge" axis="0 -1 0" damping="0.1"/>
                <geom name="point A" type="cylinder" pos="0 0 0" size="0.005
0.005" rgba="0.89 0.14 0.16 0.5" euler="0 0 0" contype="0"/>
                <geom name="link_AB1" type="cylinder" pos="0 0 0.0468"
size="0.005 0.0468" rgba="0.2 0.4 0.9 0.7"/>
        </body>
    </worldbody>
</mujoco>
```

```

        <site name="sC1" pos="0 0 0.0936" size="0.005"/>
    </body>
</body>

<!-- Branch 2: L3 --&gt;
&lt;body name="CB2" pos="0.072 0 0.5"&gt;
    &lt;joint name="C" type="hinge" axis="0 -1 0" damping="0.1"/&gt;
    &lt;geom name="point C" type="cylinder" pos="0 0 0" size="0.005
0.005" rgba="0.89 0.14 0.16 0.5" euler="0 0 0" contype="0"/&gt;
    &lt;geom name="link_CB2" type="cylinder" pos="0 0 0.054" size="0.005
0.054" rgba="0.2 0.4 0.9 0.7"/&gt;
    &lt;site name="sC2" pos="0 0 0.108" size="0.005"/&gt;
&lt;/body&gt;

<!-- Branch 3: L6 + L7 --&gt;
&lt;body name="DFB3" pos="0.36 0 0.5"&gt;
    &lt;joint name="D" type="hinge" axis="0 -1 0" damping="0"/&gt;
    &lt;geom name="point D" type="cylinder" pos="0 0 0" size="0.005
0.005" rgba="0.89 0.14 0.16 0.5" euler="0 0 0" contype="0"/&gt;
    &lt;geom name="link_DF" type="cylinder" pos="0 0 0.036" size="0.005
0.036" rgba="0.2 0.4 0.9 0.7"/&gt;
    &lt;body name="FB3" pos="0 0 0.072"&gt;
        &lt;joint name="slider" type="slide" axis="0 0 1" limited="true"
range="-0.2 0.2" damping="0"/&gt;
        &lt;geom name="point F" type="cylinder" pos="0 0 0" size="0.005
0.005" rgba="0.89 0.14 0.16 0.5" euler="0 0 0" contype="0"/&gt;
        &lt;geom name="link_FB3" type="cylinder" pos="0 0 0.18"
size="0.005 0.18" rgba="0.2 0.4 0.9 0.7"/&gt;
        &lt;site name="sC3" pos="0 0 0.36" size="0.005"/&gt;
    &lt;/body&gt;
&lt;/body&gt;
&lt;/worldbody&gt;

<!-- all branches meet at common point --&gt;
&lt;equality&gt;
    &lt;connect site1="sC1" site2="sC2"/&gt;
    &lt;connect site1="sC1" site2="sC3"/&gt;
&lt;/equality&gt;
&lt;/mujoco&gt;
"""
</pre>

```

```
model = mujoco.MjModel.from_xml_string(xml)
data = mujoco.MjData(model)

with mujoco.viewer.launch_passive(model, data) as viewer:
    start = time.time()
    while viewer.is_running() and time.time() - start < 35:
        mujoco.mj_step(model, data)
        viewer.sync()
        time.sleep(0.11)
```

II. SIMULATION RESULT

