Singular Control
of
Phantom Omni Manipulator

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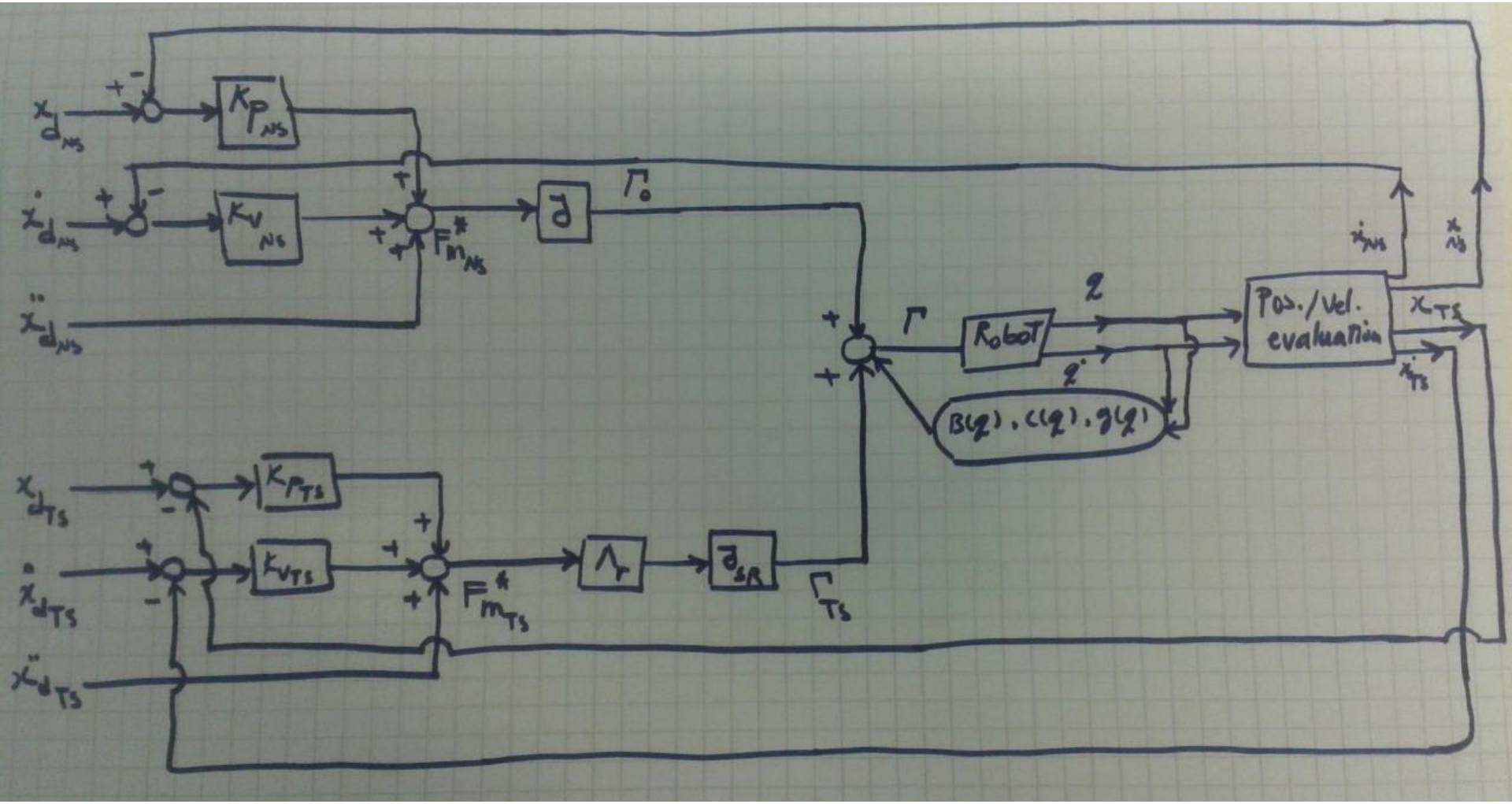
Introduction

- For achieving the dynamically consistent of the robot one of the approach is to decouple the null space motion from the task space motion.
- Dynamically consistent relationship between the joint torques and operational forces is:

$$\Gamma = J^T(q)F + \left[I - J^T(q)\bar{J}^T(q) \right]\Gamma_0$$

Controller Structure Diagram



MATLAB Simulation

First the simulation was done in MATLAB for 2R planar robot.

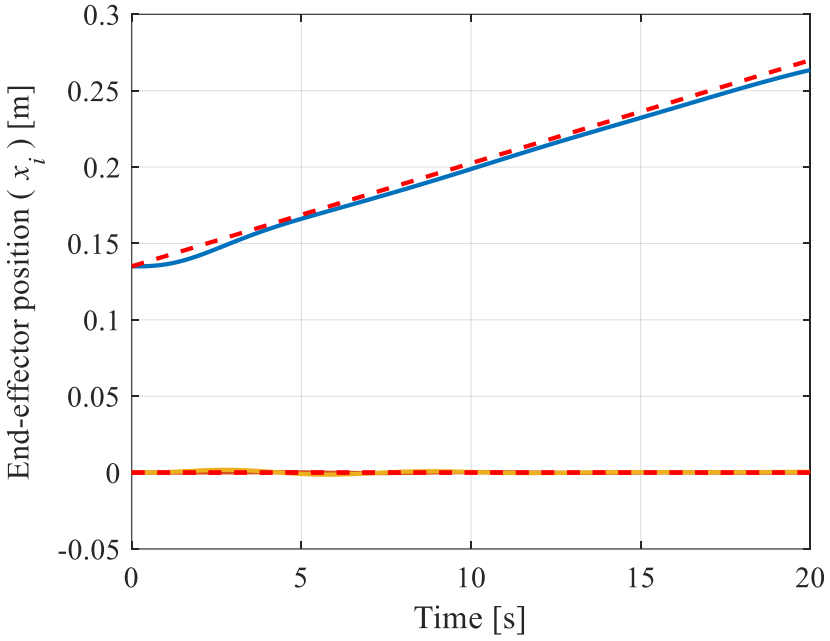
Initial position:

```
q0 = [0;-pi/3;2*pi/3]; %initial joint angles
dq0 = [0;0;0]; %initial joint velocities
```

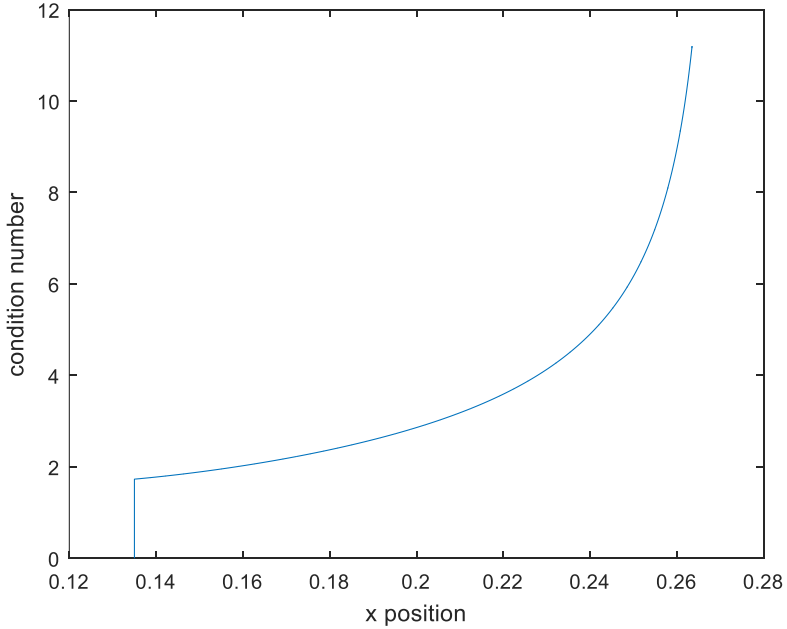
End-effector desired movement:

```
xd = [(x0(1) + 0.00675*t), zeros(Nt,1), x0(3)*ones(Nt,1)];
```

MATLAB Singular Control

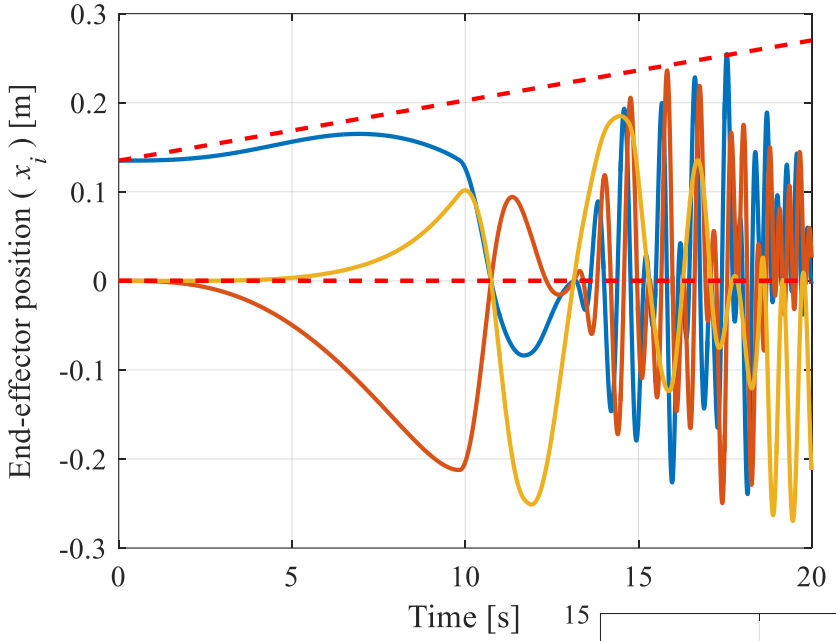


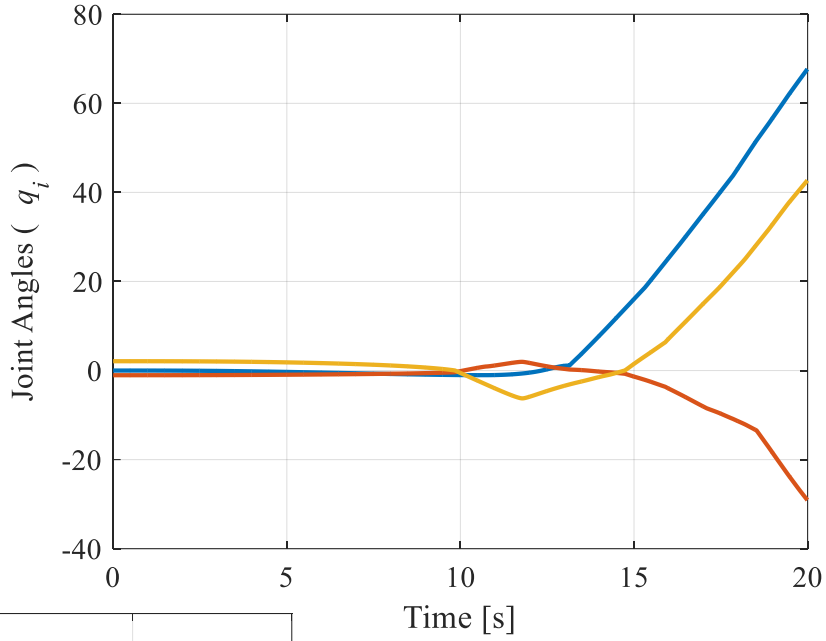
End-effector position along x-direction

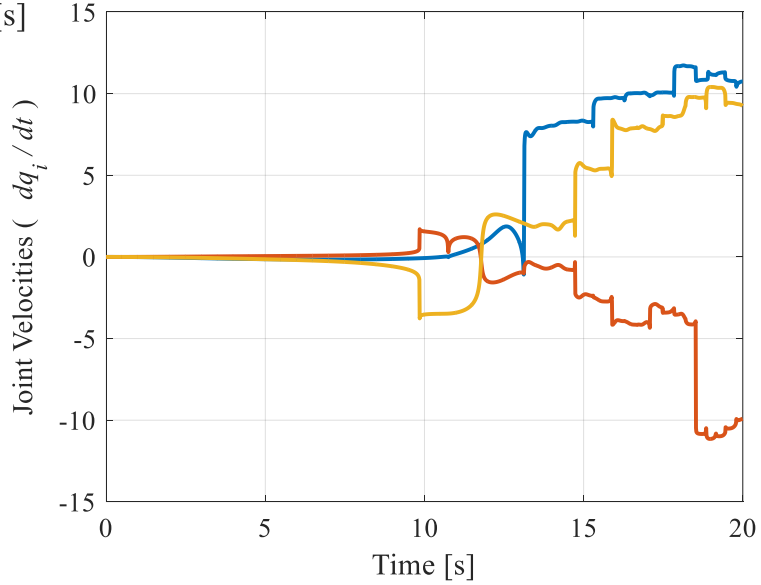


Condition Number respects to end-effector motion

MATLAB Regular Control







V-rep Simulation

In this section ,V-rep runs via MATLAB.

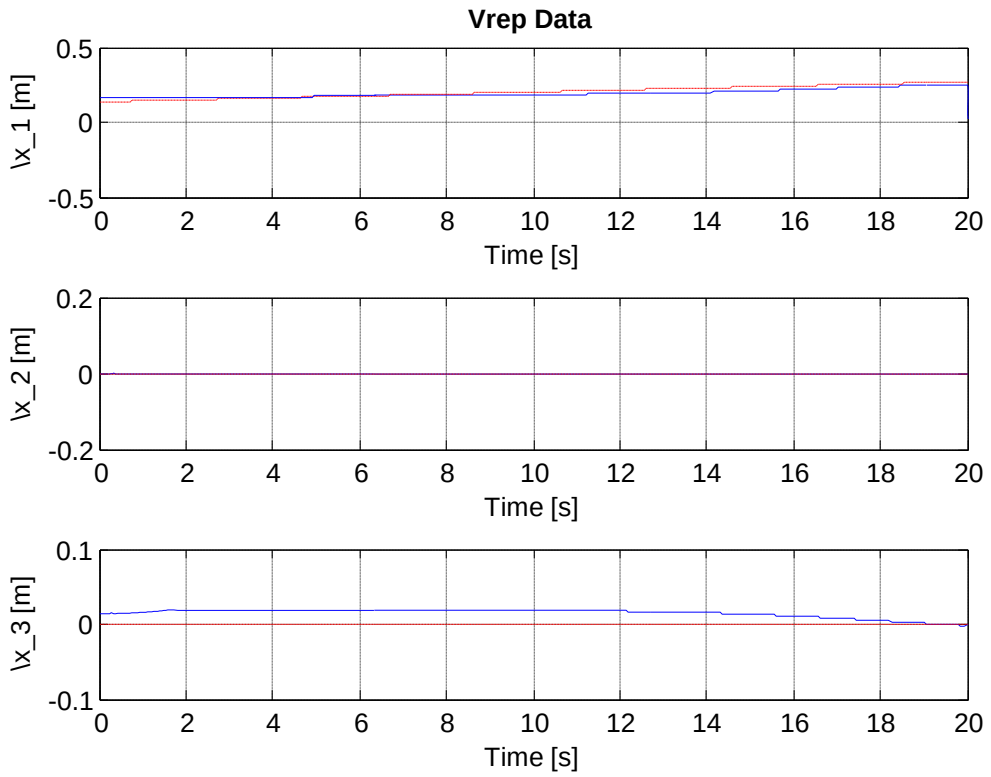
Initial position:

```
q0 = [0;60;-30]; %initial joint angles
dq0 = [0;0;0]; %initial joint velocities
```

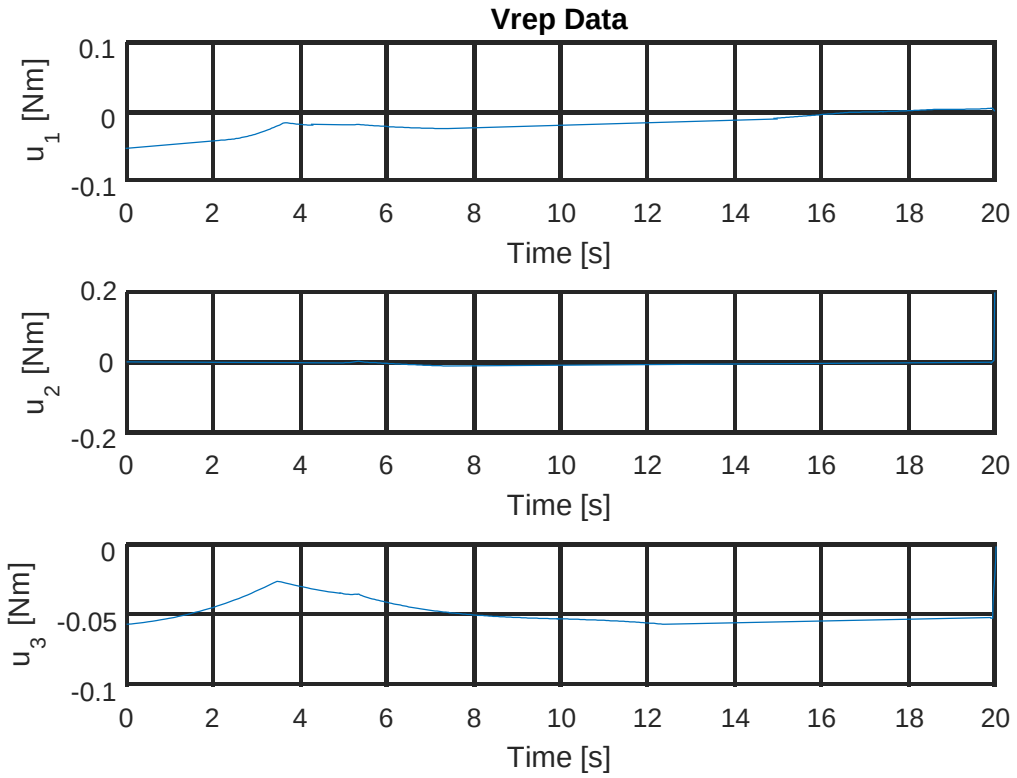
End-effector desired movement:

```
xd = [(x0(1) + 0.00675*t), zeros(Nt,1), x0(3)*ones(Nt,1)];
```

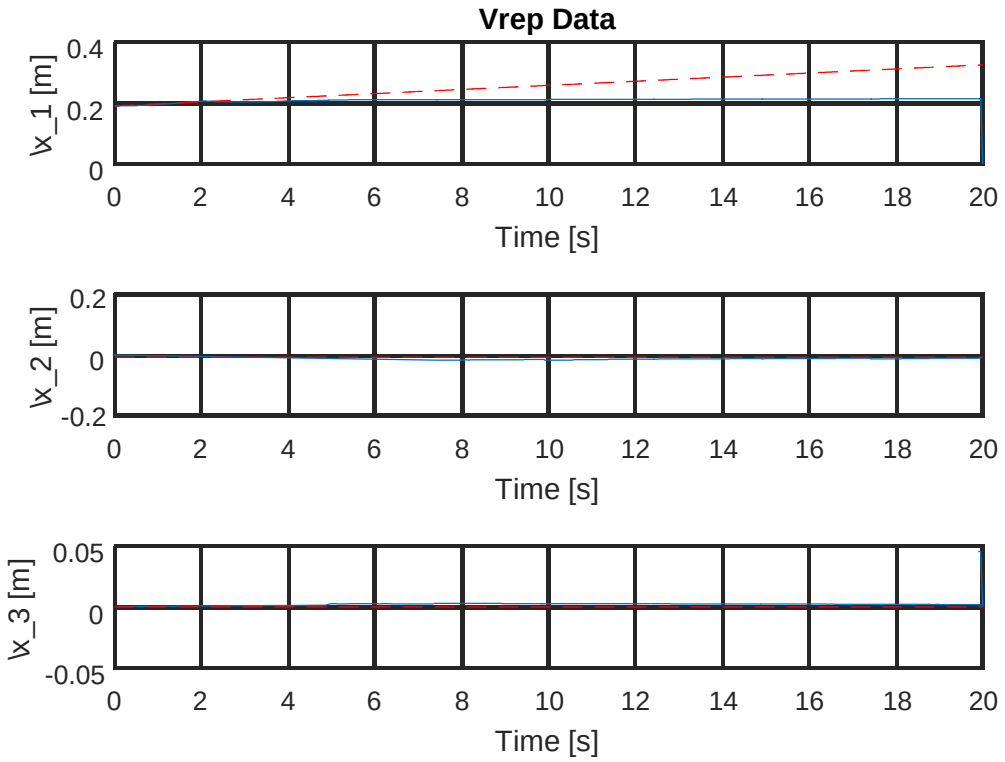
V-rep Singular control



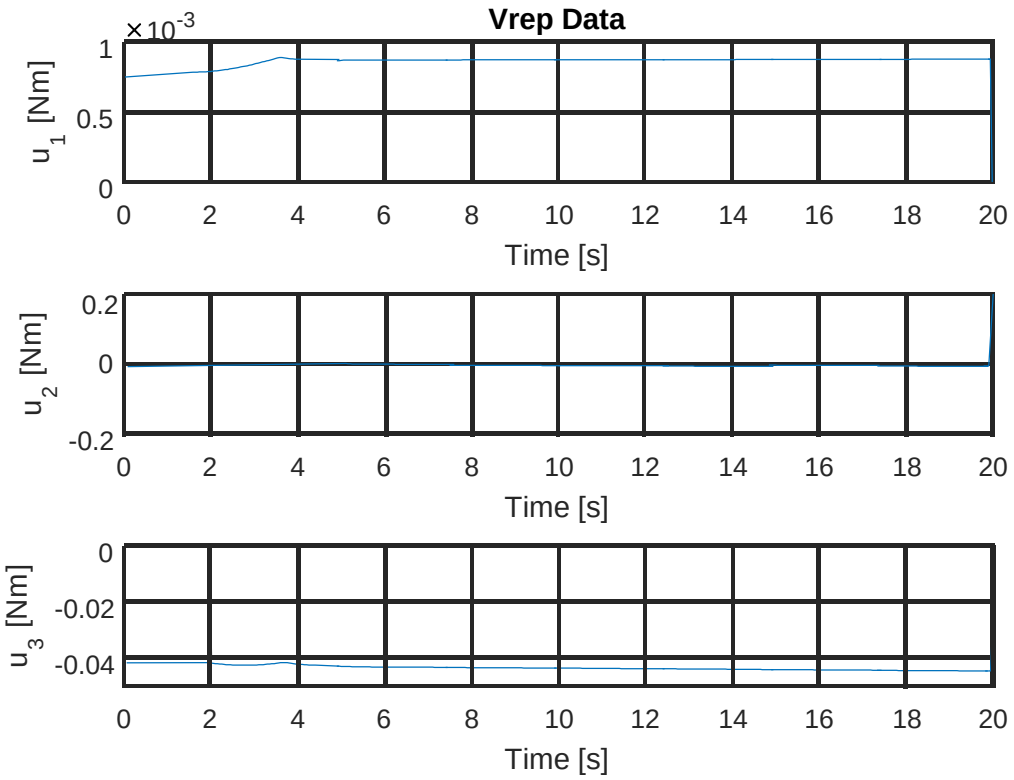
V-rep Singular control Torque



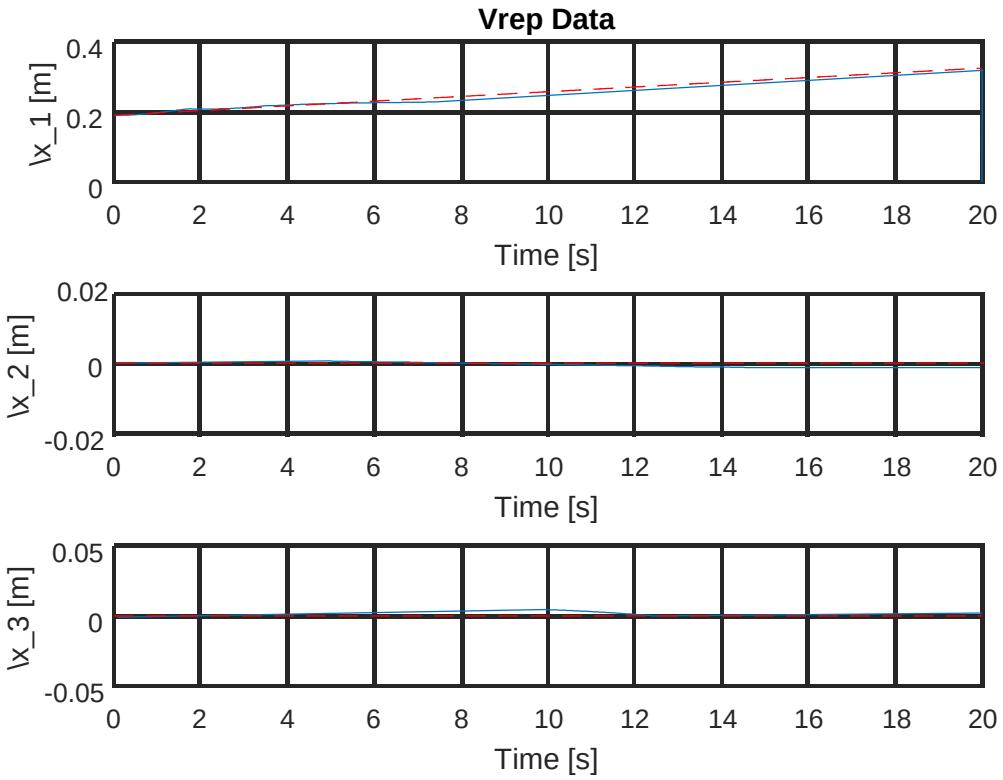
V-rep Regular control



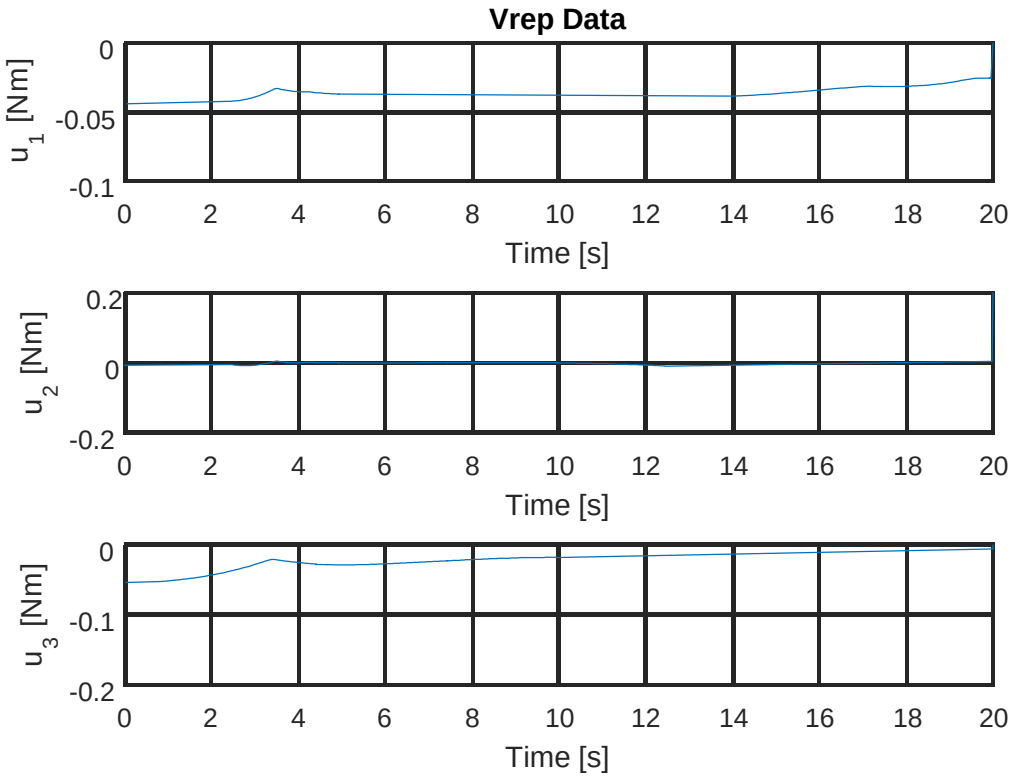
V-rep Regular control Torque



V-rep Switching control



V-rep Switching control



Problem

- The last arm of *real Omni* can not stretch because of joint limitation. So due to this limitation and also monitoring the Omni behaviour in the singular boundary and configuration the joint limit removed in Vrep simulation.
- Applying two different control on omni, Regular control and Singular control for comparing how omni behaves under those controller.
- In singular controlling the arms strech until the end effector goes in singular configuration.
- In regular controlling Omni stops and can not go through singular boundary.