FRA333

KINEMATICS OF ROBOTICS SYSTEM

GROUP 24

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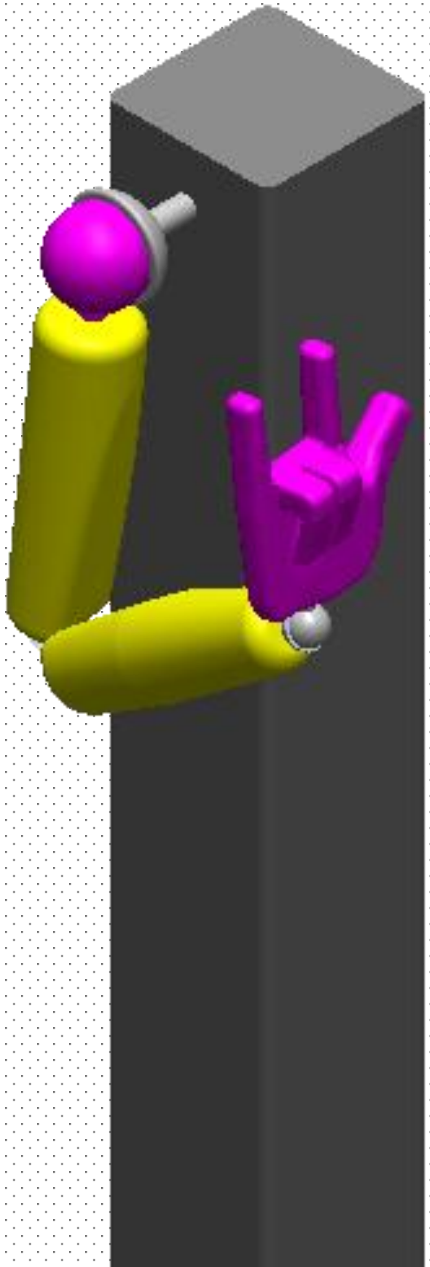


FINAL PROJECT

7 DOF MANIPULATOR SIMULATES THE JOINT PATTERN OF A HUMAN ARM KINEMATICS SIMULATION

OBJECTIVE

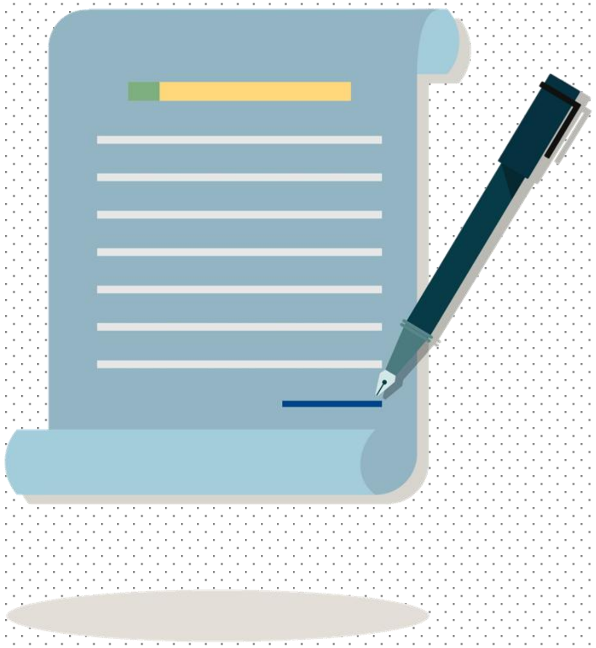
1. To create Simulation of Human arm movement.
2. To create a system to simulate the control of human arm movement.
3. To study the force in the joints of the human arm that is required when a force is applied to the end of the arm to maintain posture.
4. To study the application of Kinematics knowledge in explaining the movement and controlling the movement of the human arm.

SCOPE

1. Simulation that simulate human arm movement from shoulder to wrist.
2. The movement control system can be controlled through Configuration space by adjusting the **q** value of each joint.
3. The movement control system can be controlled through the task space by specifying a position with reference to a reference frame.
4. The movement control system can be controlled through a Task space that can move as MoveJ or MoveL.
5. The system calculates the force in each joint in the case of an external force acting at the end of the arm in the simulation when the arm is stay in place.

EXPECTED STUDY RESULTS

1. Simulation movement of the 7 DOF mechanical arm model with a 3R - R - 3R joint arrangement that can be controlled through Configuration space and Task space.
2. Controlling the simulation through task space in the MoveJ and MoveL movement.
3. Able to find the force in each joint in the case of an external force acting at the end of the mechanical arm.
4. Readme for implementing the simulation.



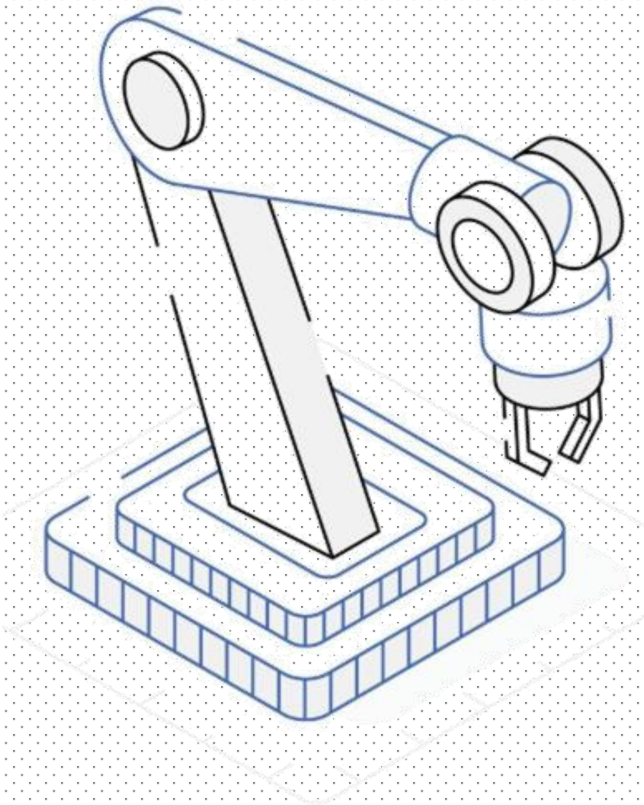
MATH AND KINEMATICS CONCEPT

MOVE-L MODE

```
target_direction = [
    target[0] - current_pos.x,
    target[1] - current_pos.y,
    target[2] - current_pos.z,
    target[3] - current_pos.rpy()[0], # roll
    target[4] - current_pos.rpy()[1], # pitch
    target[5] - current_pos.rpy()[2] # yall
]
target_direction
```

```
unit_target_direction =[
    target_direction[0] / linear_size,
    target_direction[1] / linear_size,
    target_direction[2] / linear_size,
    target_direction[3] / angular_size,
    target_direction[4] / angular_size,
    target_direction[5] / angular_size,
]
unit_target_direction
```

```
vel = [
    unit_target_direction[0] * 0.5,
    unit_target_direction[1] * 0.5,
    unit_target_direction[2] * 0.5,
    unit_target_direction[3] * 0.5,
    unit_target_direction[4] * 0.5,
    unit_target_direction[5] * 0.5,
]
```



TARGET DIRECTION

Target_pos - Current_pos = Diff_pos

Diff_pos

↓

Unit Vector

↓ ×0.01

Velocity

(x, y, z, roll, pitch, yaw)

MATH AND KINEMATICS CONCEPT

MOVE-L MODE

JACOBIAN

$$J^{\dagger} = J^{T}\left(JJ^{T}\right)^{-1}$$

MATH AND KINEMATICS CONCEPT

MOVE-L MODE

CALCULATE

q dot

$$\dot{q} = J^{\dagger}(q)\dot{x}$$

CALCULATE

Joint Effort

$$\mathbf{t} = J^{\mathbf{T}}(q)w$$

MATH AND KINEMATICS CONCEPT

MOVE-L MODE

Find Singularity

Use Singular Value Decomposition (SVD)

GITHUB

Link :

https://github.com/PoFamily/human_arm_ws.git

THANK YOU

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KINEMATICS OF ROBOTICS SYSTEM