# Foundations of Robotics – Project 2 Report

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A picture containing text, sky, map, outdoor

Description automatically generated

The Manipulator parameters are,

Text

Description automatically generated

The frames are depicted into the figure and the DH parameters are,

Table

Description automatically generated

Part 1:-

Methodology:

Here, in this part we’ve used Matlab/Simulink algorithm to obtain Second Order Kinematic Inversion of Jacobian.

To find the Second Order Kinematic inversion we’ve considered the following,



Here the jacobian considered inorder to obtain the Second order Kinematic inversion is,

Text, letter

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We’ve used Jacobian\_dot to provide input value of J\_dot\*q\_dot and Jacobian\_inverse for q double dot in simulink model.

The Position and Orientation expression for the end effector is defined in the direct\_kin file. The translation part of the homogeneous transformation from base to end effector is considered as 3X1 form then the angles are included in new matrix to obtain Position and Orientation.

HT(Base-End Effector)=

Text

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[Position, Orientation] =

Text, letter

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Finally, after defining all the function in their respective Simulink file, all the visualization and loading the trajectory from the predefined file is happening in init.m with the help of Kinematic\_traj and visualize\_results files.

The formula used to obtain the plot of error and link variables is,



**Result:**

Simulink Model:

Diagram, schematic

Description automatically generated

Here, the Simulink Model for the second order kinematic inversion have been created in clik\_inverse Simulink file. All the input variables are being imported from the workspace by using ‘From Workspace’ blocks and the all the output variables are exported back to workspace by ‘To Workspace’ blocks which are being visualized.

Plots:

Chart, line chart

Description automatically generated Chart, line chart

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**Here,**

1.\_Error in ‘X’ axis of End Frame. 1. Revolute Joint Angel – q1.

2. Error in ‘Y’ axis of End Frame. 2. Revolute Joint Angel – q2.

3. Error in 'Z’ axis of End Frame. 3. Prismatic Joint Angel – q3.

4. Orientation in End Frame. 4. Revolute Joint Angel – q4.

**Part 2:**

**Methodology:**

The maximum distance is found using the below formula, where the Z component is relaxed.



The algorithmic solution based on the jacobian-pseudo inverse is generalised using,



The Jacobian and pseudo Jacobian used to obtain the output is,

Text, letter

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Text

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Result:

Simulink model:

Diagram

Description automatically generated

Jacobian\_z\_relax

Here the Jacobian\_Z\_relax is implemented into the model in the interpreted Matlab function and Position variables are defined in the direct\_kin, jacobian dot in Jacobian\_dot and Jacobian in Jacobian Matlab Function.

**Plots:**

**Graphical user interface, chart, line chart

Description automatically generated Chart, line chart

Description automatically generated**

**Here,**

1.Error in ‘X’ axis of End Frame. 1. Revolute Joint Angel – q1.

2. Error in ‘Y’ axis of End Frame. 2. Revolute Joint Angel – q2.

3. Orientaion in End Frame. 3. Prismatic Joint Angel – q3

4. Revolute Joint Angel – q4