SOLUTION

Rigid Transformations & Forward Kinematics

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Gen3 lite Cursus

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Manipulations

Part 1: Implementation of the forward kinematics

1.1

They are obtained by taking $^{i-1}\mathbf{T}^*_i\ \mathbf{R}_z(\boldsymbol{\theta}_i)$ because all the actuator axes are aligned with the Z-axis of their respective reference frames.

1.2-1.4

See associated .m files and Table 49 in the User Guide.

Part 2: Validation with the robot

2.1

The exact values for the pose may be different from robot to robot, but should all be close to the following. Check with your own robot for more accurate results.

Test #	$\boldsymbol{\theta}$ (deg)	[x, y, z, $\boldsymbol{\theta}_x$, $\boldsymbol{\theta}_y$, $\boldsymbol{\theta}_z$]
1	[0, 0, 0, 0, 0, 0,]	[0.057, 0.01, 1.003, 0, 0, 90]
2	[90, 0, 0, 45, 45, 45]	[0.087, 0.158, 0.0934, 145, -150, 100]
3	[0, 344, 75, 0, 300, 0]	[0.439, 0.193, 0.448, 90, -1, 150]
4	[7, 21, 150, 285, 340, 270]	[0.207, -0.019, 0.139, 30, 168, 87]

TABLE 2: Angular positions to test

2.2

The theoretical results should be very close, but not quite perfect.

2.3

There are unique manufacturing defects on each unit making the ideal DH parameters given by the user guide not exact. Another valid answer is also that the robot has a tolerance on its destination when commanded using the API.

2.4

Using rigid body transformation allows more freedom when choosing how to locate the reference frames and allows to add intermediate static transformations in the middle of the kinematic chain, such as corrections to an ideal model.

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