Algorithm for 3D Cube Rotation Around an Arbitrary Axis

Step 1: Input Data

• Define the cube with its vertices and edges.

• Define the rotation axis using two points (x_1, y_1, z_1) and (x_2, y_2, z_2).

• Define the rotation angle (in degrees).

Step 2: Initialize Variables

• Compute the direction vector of the rotation axis:

$dx = x_2 - x_1$, $dy = y_2 - y_1$, $dz = z_2 - z_1$

• Normalize the direction vector:

$length = sqrt(dx^2 + dy^2 + dz^2)$

$dx = dx / length$, $dy = dy / length$, $dz = dz / length$

• Compute alignment angles:

- $\alpha = arctan2(dy, dz)$ (Rotation around X-axis)

- $\beta = arctan2(dx, sqrt(dy^2 + dz^2))$ (Rotation around Y-axis)

Step 3: Construct Transformation Matrices

1. Translation to Origin: Moves the axis start point to (0,0,0).

2. Rotation to Align Axis with Z-axis:

   - Rotate around X-axis by α.

   - Rotate around Y-axis by β.

3. Perform Rotation:

   - Rotate around Z-axis by the given angle.

4. Inverse Transformations:

   - Rotate back around Y-axis by $-\beta$.

   - Rotate back around X-axis by $-\alpha$.

   - Translate back to the original position.

Step 4: Apply Transformation

• Multiply the transformation matrix with all cube vertices.

• Store the transformed vertices.

Step 5: Visualization

• Plot the original cube.

• Plot the transformed cube after rotation.

• Display the rotation axis as a dashed red line.

Step 6: Output

• Print the transformation matrix.

• Display both original and rotated cubes in a 3D plot.