Interactive Graphical User Interface for 3D Transformation of Geometrical Shapes

Transformation Matrices:-

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & \Delta x \\ 0 & 1 & 0 & \Delta y \\ 0 & 0 & 1 & \Delta z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Translation

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \lambda_x & 0 & 0 & 0 \\ 0 & \lambda_y & 0 & 0 \\ 0 & 0 & \lambda_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Scaling

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Reflection across YZ

Rotation about z-axis

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta & 0 & 0 \\ \sin\theta & \cos\theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Rotation about y-axis

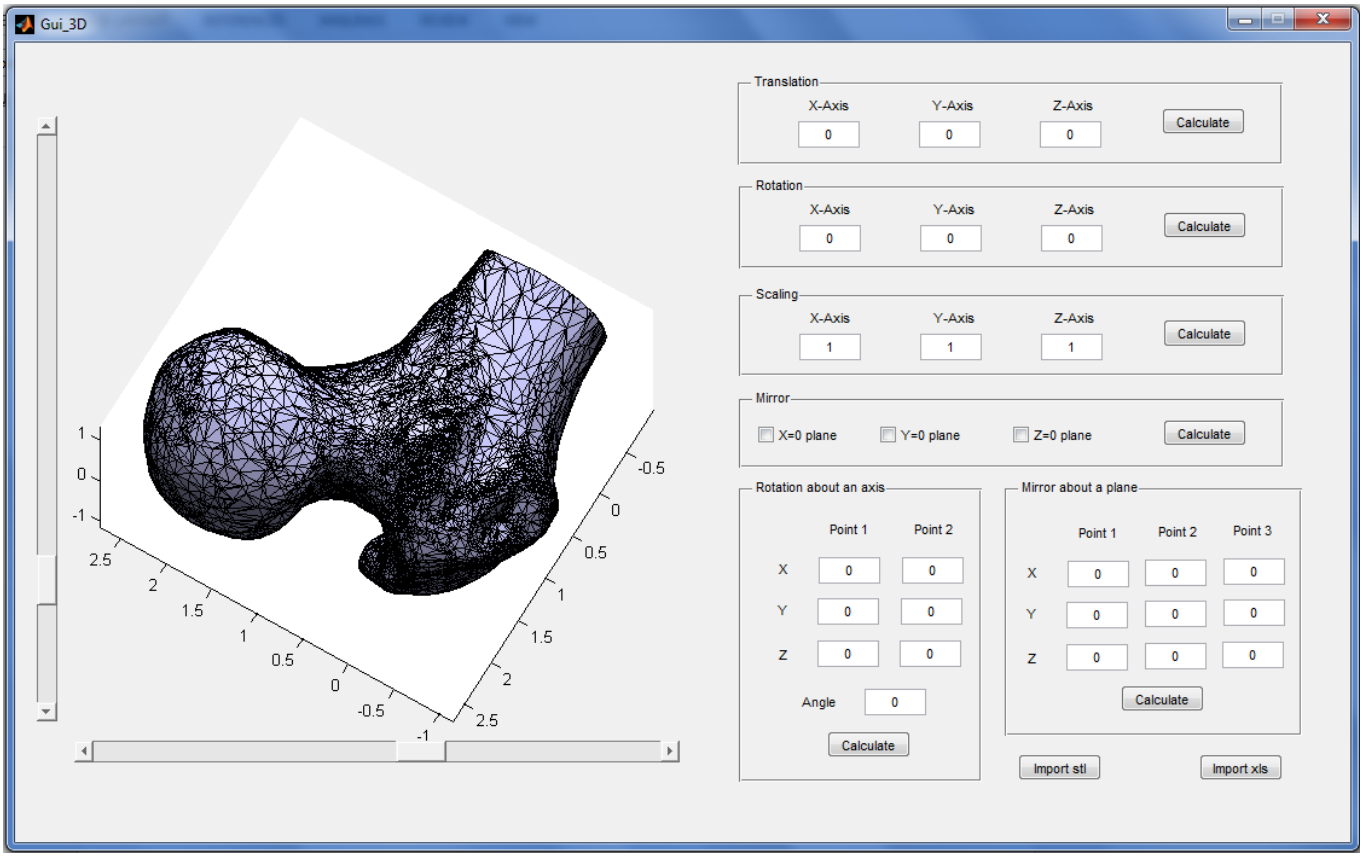
$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\theta & 0 & \sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Rotation about x-axis

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Rotation about an Arbitrary Axis $[M]= [T]\ [R_x]\ [R_y]\ [R_{theta}]\ [R_y]^{-1}\ [R_x]^{-1}\ [T]^{-1}$

Reflection across an Arbitrary Plane $[M]= [T]\ [R_x]\ [R_y]\ [Refl_z]\ [R_y]^{-1}\ [R_x]^{-1}\ [T]^{-1}$



Example of an input from stl file of Human Bone

Input form:-

solid vcg

facet normal -2.320966e-003 -9.999969e-001 -8.762344e-004

outer loop

vertex -2.468989e-001 -9.935274e-001 3.039794e-001

vertex -2.583674e-001 -9.935263e-001 3.332009e-001

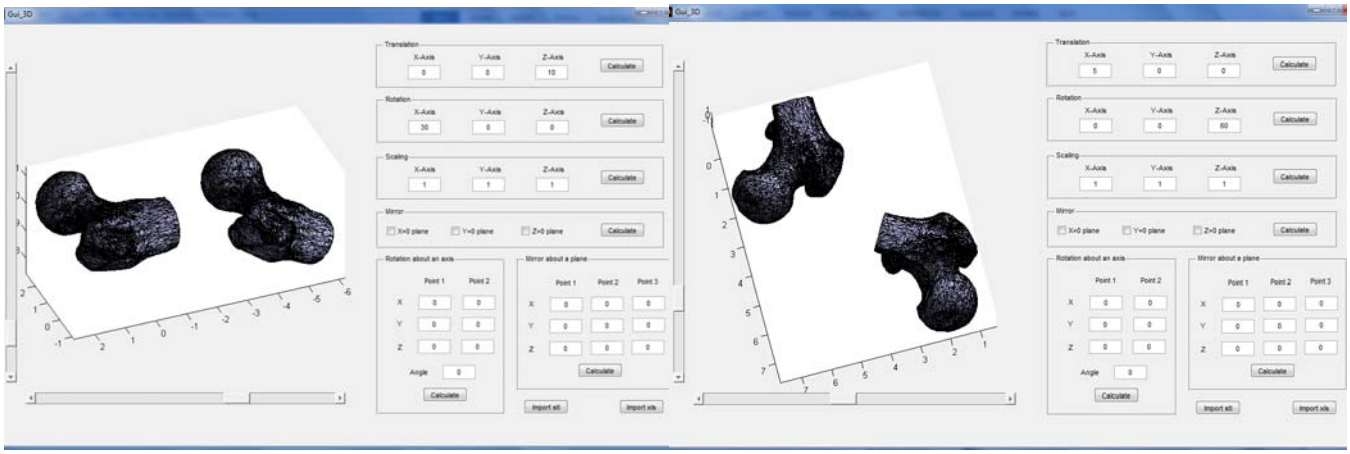
vertex -2.468989e-001 -9.935204e-001 2.960206e-001

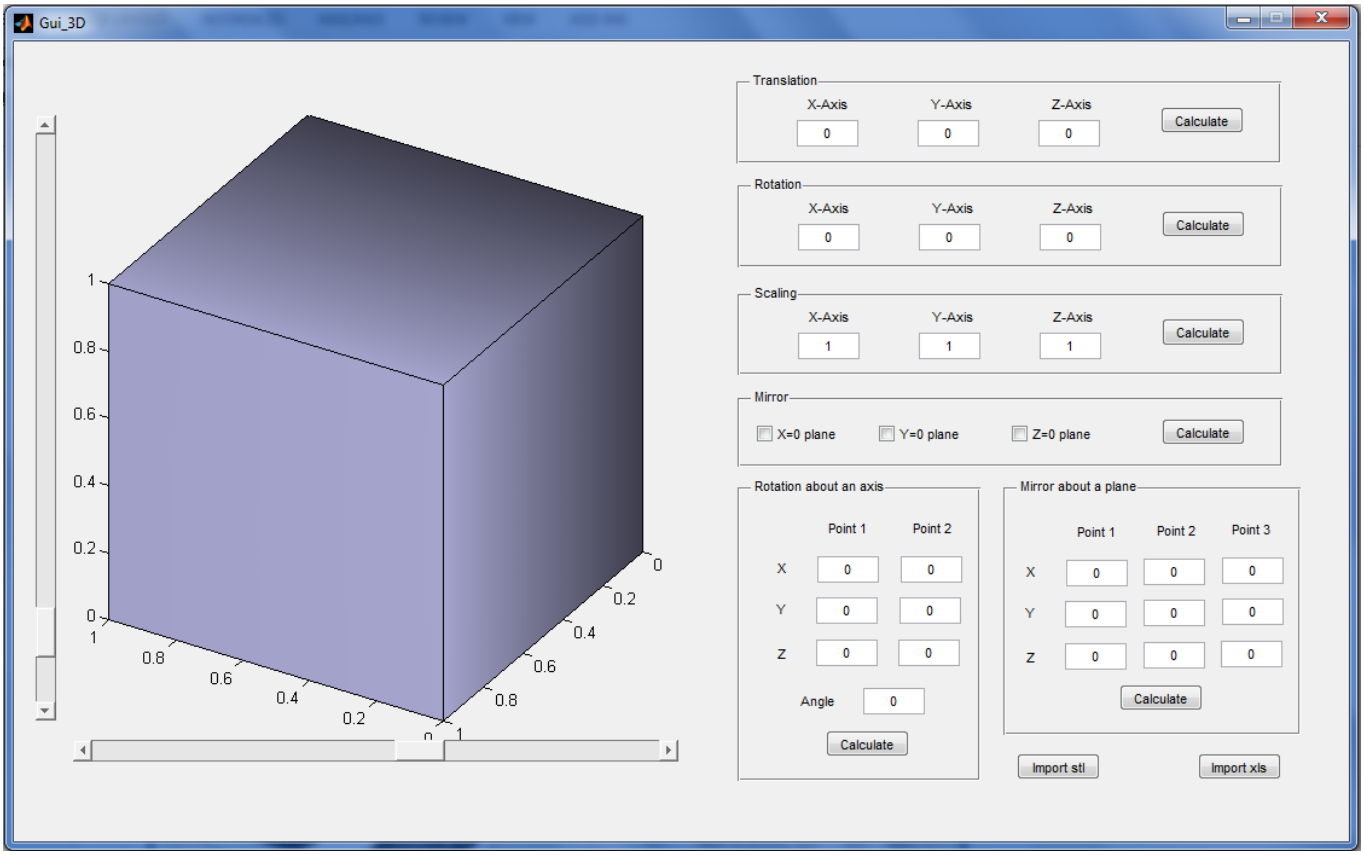
endloop

endfacet

facet normal -2.323857e-003 -9.999969e-001 -8.773699e-004

…





Example of an input from xls file of a Simple Cube

Input form:-

Points

0	0	0
1	0	0
1	1	0
0	1	0
0	0	1
1	0	1
1	1	1
0	1	1

Faces

1	2	3	4
5	6	7	8
1	2	6	5
3	4	8	7
1	4	8	5
2	3	7	6