

Tetrahedral Volume given four points being x,y,z as column vector

$$tetra(p, u, v, w) := \left\| \begin{array}{l} uvw \leftarrow (w-u) \times (v-u) \\ vol \leftarrow \frac{abs(uvw \cdot -p - uvw \cdot -u)}{6.0} \\ vol \end{array} \right\|$$

Brick Volume given eight points being x,y,z as column vector

$$brick8(i, j, k, l, m, n, o, p) := \left\| \begin{array}{l} s \leftarrow tetra(i, m, n, p) \\ s \leftarrow tetra(k, o, n, p) + s \\ s \leftarrow tetra(n, j, k, i) + s \\ s \leftarrow tetra(p, l, k, i) + s \\ s \leftarrow tetra(k, i, n, p) + s \\ s \end{array} \right\|$$

$$S_1 := \begin{bmatrix} 0 & -5 & 0 \\ 0 & 5 & 0 \\ 0 & 5 & 10 \\ 0 & -5 & 10 \\ 0 & -5 & 0 \end{bmatrix} \quad S_2 := \begin{bmatrix} 8 & -5 & 0 \\ 8 & 5 & 0 \\ 8 & 5 & 10 \\ 8 & -5 & 10 \\ 8 & -5 & 0 \end{bmatrix}$$

$$brick8 \left(\begin{bmatrix} 0 \\ -5 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 5 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 5 \\ 10 \end{bmatrix}, \begin{bmatrix} 0 \\ -5 \\ 10 \end{bmatrix}, \begin{bmatrix} 8 \\ -5 \\ 0 \end{bmatrix}, \begin{bmatrix} 8 \\ 5 \\ 0 \end{bmatrix}, \begin{bmatrix} 8 \\ 5 \\ 10 \end{bmatrix}, \begin{bmatrix} 8 \\ -5 \\ 10 \end{bmatrix} \right) = 800 \quad \text{Answer is correct}$$

Centroid of a Tetrahedron

$$tetraG(p, u, v, w) := \left\| \begin{array}{l} x \leftarrow (p_{ORIGIN} + u_{ORIGIN} + v_{ORIGIN} + w_{ORIGIN}) \cdot 0.25 \\ y \leftarrow (p_{ORIGIN+1} + u_{ORIGIN+1} + v_{ORIGIN+1} + w_{ORIGIN+1}) \cdot 0.25 \\ z \leftarrow (p_{ORIGIN+2} + u_{ORIGIN+2} + v_{ORIGIN+2} + w_{ORIGIN+2}) \cdot 0.25 \\ \begin{bmatrix} x \\ y \\ z \end{bmatrix} \end{array} \right\|$$

Centroid of a Brick defined by eight points

$$brickG(i, j, k, l, m, n, o, p) := \left\| \begin{array}{l} Vol \leftarrow brick8(i, j, k, l, m, n, o, p) \\ c1 \leftarrow tetra(i, m, n, p) \cdot tetraG(i, m, n, p) \\ c2 \leftarrow tetra(k, o, n, p) \cdot tetraG(k, o, n, p) \\ c3 \leftarrow tetra(n, j, k, i) \cdot tetraG(n, j, k, i) \\ c4 \leftarrow tetra(p, l, k, i) \cdot tetraG(p, l, k, i) \\ c5 \leftarrow tetra(k, i, n, p) \cdot tetraG(k, i, n, p) \\ cg \leftarrow \frac{(c1 + c2 + c3 + c4 + c5)}{Vol} \\ cg \end{array} \right\|$$

$$\mathit{brickG}\left(\begin{bmatrix} 0 \\ -5 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 5 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 5 \\ 10 \end{bmatrix}, \begin{bmatrix} 0 \\ -5 \\ 10 \end{bmatrix}, \begin{bmatrix} 8 \\ -5 \\ 0 \end{bmatrix}, \begin{bmatrix} 8 \\ 5 \\ 0 \end{bmatrix}, \begin{bmatrix} 8 \\ 5 \\ 10 \end{bmatrix}, \begin{bmatrix} 8 \\ -5 \\ 10 \end{bmatrix}\right) = \begin{bmatrix} 4 \\ 0 \\ 5 \end{bmatrix} \quad \text{Answer is correct}$$