Creating surface thickness with triangular meshes

The solid is formed from the initial surface, the offset surface, and the lateral surface that connects them. The lateral surface is formed by normals reconstructed from the boundary nodal points of the initial surface.

Rezonar's triangular mesh

$$m1 := pR(b_1, b_2, n_1) \quad m2 := pR(b_3, b_4, n_2)$$

$$Solid(x, h) :=$$

$$c := [1..3] \quad g_c := \frac{d}{dx_c} f(x) \quad G(x) := g \quad u(x) := \frac{G(x)^T}{norme(G(x))}$$

for $k \in [1..rows(initSur)]$

$nodeInit_k := eval(row(initSur, k))$

$nodeOffset_k := eval(nodeInit_k + h \cdot u(nodeInit_k))$

if $k = 1$

$meshOffset := nodeOffset_k$

else

$meshOffset := stack(meshOffset, nodeOffset_k)$

$a := pTMesh(F, pR(b_1, b_1, 1), m2) \quad c := pTMesh(F, m1, pR(b_3, b_3, 1))$

$d := pTMesh(F, pR(b_2, b_2, 1), m2) \quad \mathbf{e} := pTMesh(F, m1, pR(b_4, b_4, n_2))$

$border := stack(a, c, d, \mathbf{e})$

$k := [1..rows(border)] \quad nodeB_k := eval(row(border, k))$

$normalB_k := eval(stack(nodeB_k, nodeB_k + h \cdot u(nodeB_k)) \cdot \gamma \cdot zum)$

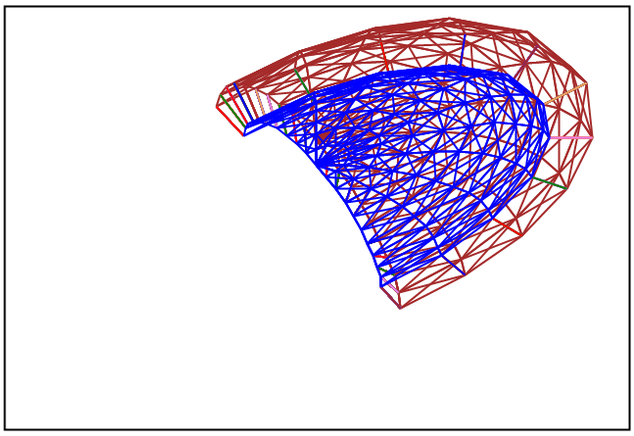
$solid := eval(stack([initSur \cdot \gamma \cdot zum], normalB, "", "", [meshOffset \cdot \gamma \cdot zum]))$

$eval(mat2sys_1(solid))$

$$f(x) := \frac{(x_1)^2}{9^2} + \frac{(x_2)^2}{4.5^2} + \frac{(x_3)^2}{3^2} - 1$$

$$F(u, v) := \begin{bmatrix} 9 \cdot \sin(u) \cdot \cos(v) \\ 4.5 \cdot \sin(u) \cdot \sin(v) \\ 3 \cdot \cos(u) \end{bmatrix}$$

$b := [0.5 \cdot \pi \ 0 \ 1.5 \cdot \pi \ 0.5 \cdot \pi] \quad n := [10 \ 10] \quad initSur := pTMesh(F, m1, m2)$

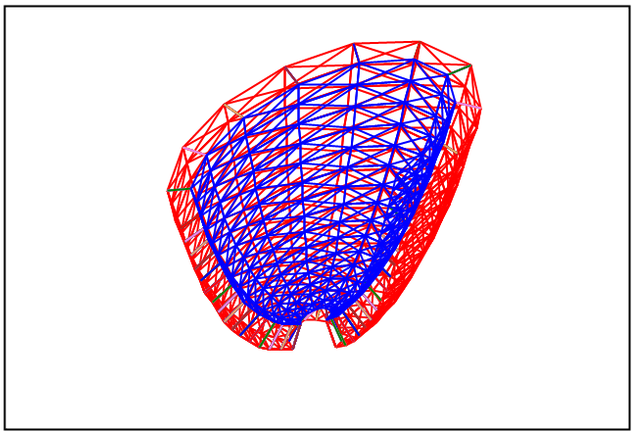


$Solid(x, 1.5)$

$$f(x) := \frac{x_1^2}{2^2} + \frac{(x_2)^2}{1^2} - x_3 + 5$$

$$F(u, v) := \begin{bmatrix} 2 \cdot u \cdot \cos(v) \\ 1 \cdot u \cdot \sin(v) \\ u^2 - 5 \end{bmatrix}$$

$b := [0.3 \ 3 \ -1.4 \cdot \pi \ 0]$ $n := [15 \ 10]$ $initSur := pTMesh(F, m1, m2)$

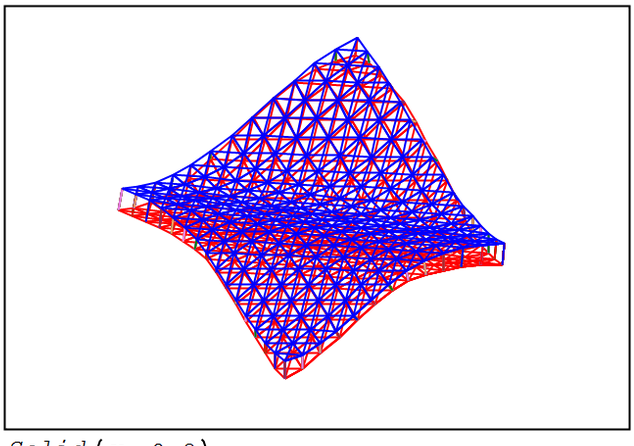


$Solid(x, 1)$

$$f(x) := \sin(0.5 \cdot x_1 + 0.5 \cdot x_2) - x_3$$

$$F(u, v) := \begin{bmatrix} u \\ v \\ \sin(0.5 \cdot u + 0.5 \cdot v) \end{bmatrix}$$

$b := [-5 \ 5 \ -5 \ 5]$ $n := [12 \ 15]$ $initSur := pTMesh(F, m1, m2)$

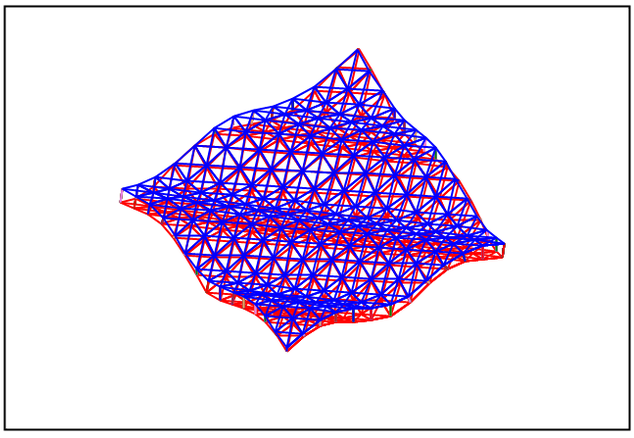


$Solid(x, 0.8)$

$$f(x) := 0.5 \cdot \sin(x_1 + x_2) - x_3$$

$$F(u, v) := \begin{bmatrix} u \\ v \\ 0.5 \cdot \sin(u + v) \end{bmatrix}$$

$b := [-5 \ 5 \ -5 \ 5]$ $n := [12 \ 14]$ $initSur := pTMesh(F, m1, m2)$

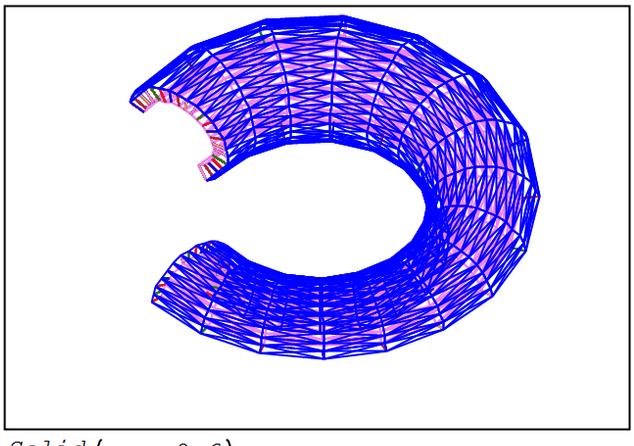


$Solid(x, 0.5)$

$$f(x) := \left(\sqrt{x_1^2 + x_2^2} - 6\right)^2 - 2^2 + x_3^2$$

$$F(u, v) := \begin{bmatrix} (6 + 2\cdot\cos(u))\cdot\cos(v) \\ (6 + 2\cdot\cos(u))\cdot\sin(v) \\ 2\cdot\sin(u) \end{bmatrix}$$

$b := [0\ 4\ 0\ 5]$ $\quad n := [20\ 15]$ $\quad initSur := pTMesh(F, m1, m2)$

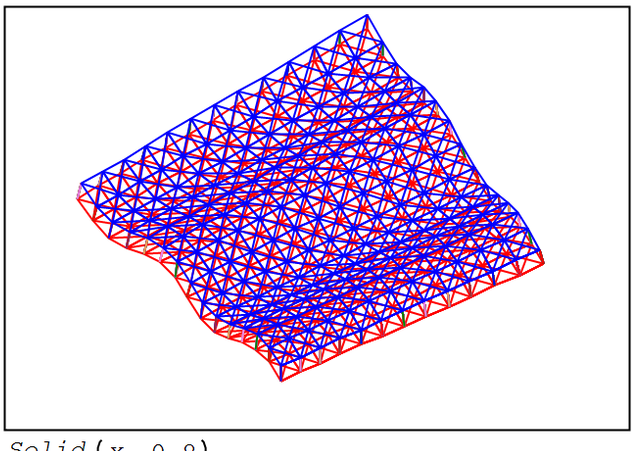


$Solid(x, -0.6)$

$$f(x) := 0.5\cdot\left(\sin\left(2\cdot\pi x_1\right) + \sin\left(2\cdot\pi x_2\right)\right) - x_3$$

$$F(u, v) := \begin{bmatrix} u \\ v \\ 0.5\cdot\left(\sin(2\cdot\pi\cdot u) + \sin(2\cdot\pi\cdot v)\right) \end{bmatrix}$$

$b := [-6\ 6\ -6\ 6]$ $\quad n := [12\ 14]$ $\quad initSur := pTMesh(F, m1, m2)$



$Solid(x, 0.8)$