https://github.com/t-o-k/Maxima-bezier/rational_bezier_surface_3d.mac

```
(%i1) kill(all)$

(%i2) load("draw")$
      load("bezier")$

(%i3) tau: 2*%pi$

(%i4) angle: tau/4$

(%i5) w: matrix([ 1, cos(angle/2), 1 ]);
```

(w)
$$\begin{pmatrix} 1 & \frac{1}{\sqrt{2}} & 1 \end{pmatrix}$$

```
(%i6) weights: transpose(w).w;
```

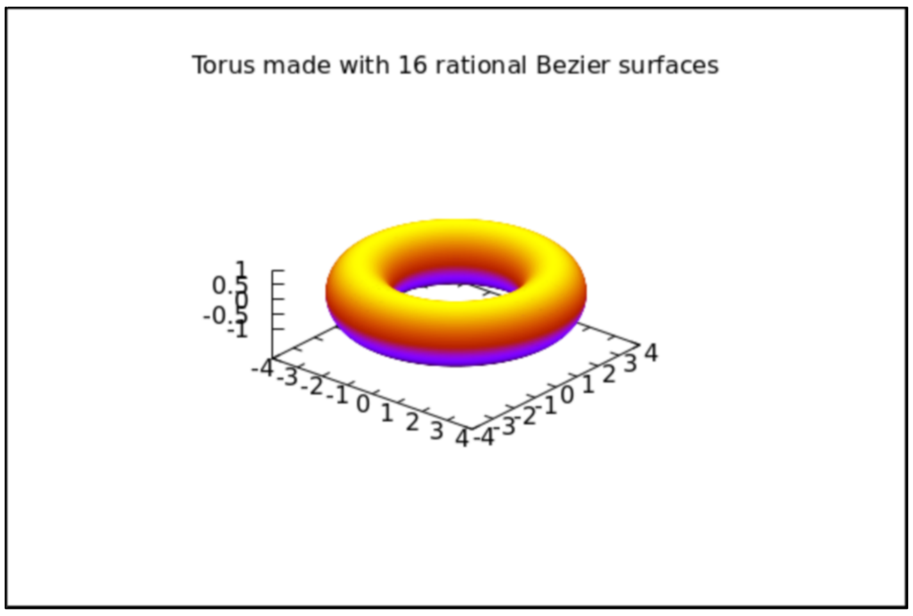
(weights)
$$\begin{pmatrix} 1 & \frac{1}{\sqrt{2}} & 1 \\ \frac{1}{\sqrt{2}} & \frac{1}{2} & \frac{1}{\sqrt{2}} \\ 1 & \frac{1}{\sqrt{2}} & 1 \end{pmatrix}$$

```
(%i11) maj_x: matrix([ 0, 1, 1 ], [ 0, 1, 1 ], [ 0, 1, 1 ])$
       min_x: matrix([ 0, 1, 1 ], [ 0, 1, 1 ], [ 0, 0, 0 ])$

       maj_y: matrix([ 1, 1, 0 ], [ 1, 1, 0 ], [ 1, 1, 0 ])$
       min_y: matrix([ 1, 1, 0 ], [ 1, 1, 0 ], [ 0, 0, 0 ])$

       min_z: matrix([ 0, 0, 0 ], [ 1, 1, 1 ], [ 1, 1, 1 ])$

(%i14) define(f01_x(u, v), rational_bezier_function_2a(+r_maj*maj_x +r_min*min_x, weights, u, v))$
       define(f01_y(u, v), rational_bezier_function_2a(+r_maj*maj_y +r_min*min_y, weights, u, v))$
       define(f01_z(u, v), rational_bezier_function_2a(             +r_min*min_z, weights, u, v))$

(%i17) define(f02_x(u, v), rational_bezier_function_2a(+r_maj*maj_x +r_min*min_x, weights, u, v))$
       define(f02_y(u, v), rational_bezier_function_2a(+r_maj*maj_y +r_min*min_y, weights, u, v))$
       define(f02_z(u, v), rational_bezier_function_2a(              -r_min*min_z, weights, u, v))$

(%i20) define(f03_x(u, v), rational_bezier_function_2a(+r_maj*maj_x  -r_min*min_x, weights, u, v))$
       define(f03_y(u, v), rational_bezier_function_2a(+r_maj*maj_y  -r_min*min_y, weights, u, v))$
       define(f03_z(u, v), rational_bezier_function_2a(             +r_min*min_z, weights, u, v))$

(%i23) define(f04_x(u, v), rational_bezier_function_2a(+r_maj*maj_x  -r_min*min_x, weights, u, v))$
       define(f04_y(u, v), rational_bezier_function_2a(+r_maj*maj_y  -r_min*min_y, weights, u, v))$
       define(f04_z(u, v), rational_bezier_function_2a(              -r_min*min_z, weights, u, v))$

(%i26) define(f05_x(u, v), rational_bezier_function_2a( -r_maj*maj_x  -r_min*min_x, weights, u, v))$
       define(f05_y(u, v), rational_bezier_function_2a(+r_maj*maj_y +r_min*min_y, weights, u, v))$
       define(f05_z(u, v), rational_bezier_function_2a(             +r_min*min_z, weights, u, v))$

(%i29) define(f06_x(u, v), rational_bezier_function_2a( -r_maj*maj_x   -r_min*min_x, weights, u, v))$
       define(f06_y(u, v), rational_bezier_function_2a(+r_maj*maj_y +r_min*min_y, weights, u, v))$
       define(f06_z(u, v), rational_bezier_function_2a(              -r_min*min_z, weights, u, v))$

(%i32) define(f07_x(u, v), rational_bezier_function_2a( -r_maj*maj_x +r_min*min_x, weights, u, v))$
       define(f07_y(u, v), rational_bezier_function_2a(+r_maj*maj_y  -r_min*min_y, weights, u, v))$
       define(f07_z(u, v), rational_bezier_function_2a(             +r_min*min_z, weights, u, v))$
```

```
(%i35) define(f08_x(u, v), rational_bezier_function_2a( -r_maj*maj_x +r_min*min_x, weights, u, v))$
       define(f08_y(u, v), rational_bezier_function_2a(+r_maj*maj_y  -r_min*min_y, weights, u, v))$
       define(f08_z(u, v), rational_bezier_function_2a(                -r_min*min_z, weights, u, v))$

(%i38) define(f09_x(u, v), rational_bezier_function_2a( -r_maj*maj_x +r_min*min_x, weights, u, v))$
       define(f09_y(u, v), rational_bezier_function_2a( -r_maj*maj_y +r_min*min_y, weights, u, v))$
       define(f09_z(u, v), rational_bezier_function_2a(               +r_min*min_z, weights, u, v))$

(%i41) define(f10_x(u, v), rational_bezier_function_2a( -r_maj*maj_x +r_min*min_x, weights, u, v))$
       define(f10_y(u, v), rational_bezier_function_2a( -r_maj*maj_y +r_min*min_y, weights, u, v))$
       define(f10_z(u, v), rational_bezier_function_2a(                -r_min*min_z, weights, u, v))$

(%i44) define(f11_x(u, v), rational_bezier_function_2a( -r_maj*maj_x  -r_min*min_x, weights, u, v))$
       define(f11_y(u, v), rational_bezier_function_2a( -r_maj*maj_y  -r_min*min_y, weights, u, v))$
       define(f11_z(u, v), rational_bezier_function_2a(               +r_min*min_z, weights, u, v))$

(%i47) define(f12_x(u, v), rational_bezier_function_2a( -r_maj*maj_x  -r_min*min_x, weights, u, v))$
       define(f12_y(u, v), rational_bezier_function_2a( -r_maj*maj_y  -r_min*min_y, weights, u, v))$
       define(f12_z(u, v), rational_bezier_function_2a(                -r_min*min_z, weights, u, v))$

(%i50) define(f13_x(u, v), rational_bezier_function_2a(+r_maj*maj_x +r_min*min_x, weights, u, v))$
       define(f13_y(u, v), rational_bezier_function_2a( -r_maj*maj_y   -r_min*min_y, weights, u, v))$
       define(f13_z(u, v), rational_bezier_function_2a(               +r_min*min_z, weights, u, v))$

(%i53) define(f14_x(u, v), rational_bezier_function_2a(+r_maj*maj_x +r_min*min_x, weights, u, v))$
       define(f14_y(u, v), rational_bezier_function_2a( -r_maj*maj_y   -r_min*min_y, weights, u, v))$
       define(f14_z(u, v), rational_bezier_function_2a(                 -r_min*min_z, weights, u, v))$

(%i56) define(f15_x(u, v), rational_bezier_function_2a(+r_maj*maj_x  -r_min*min_x, weights, u, v))$
       define(f15_y(u, v), rational_bezier_function_2a( -r_maj*maj_y +r_min*min_y, weights, u, v))$
       define(f15_z(u, v), rational_bezier_function_2a(               +r_min*min_z, weights, u, v))$

(%i59) define(f16_x(u, v), rational_bezier_function_2a(+r_maj*maj_x  -r_min*min_x, weights, u, v))$
       define(f16_y(u, v), rational_bezier_function_2a( -r_maj*maj_y +r_min*min_y, weights, u, v))$
       define(f16_z(u, v), rational_bezier_function_2a(                -r_min*min_z, weights, u, v))$

(%i61) r_maj: 3$
       r_min: 1$

(%i65) u_0: 0$
       u_1: 1$

       v_0: 0$
       v_1: 1$

 ➔     /*
       u_0: u_0 + 0.01$
       u_1: u_1 - 0.01$

       v_0: v_0 + 0.04$
       v_1: v_1 - 0.04$
       */;
```

```
(%i66) wxdraw3d(
    title = "Torus made with 16 rational Bezier surfaces",
    proportional_axes = xyz,
    colorbox = false,
    xu_grid = 20,
    yv_grid = 20,
    view = [ 65, 40 ],
    enhanced3d = true,
    parametric_surface(f01_x(u, v), f01_y(u, v), f01_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f02_x(u, v), f02_y(u, v), f02_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f03_x(u, v), f03_y(u, v), f03_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f04_x(u, v), f04_y(u, v), f04_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f05_x(u, v), f05_y(u, v), f05_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f06_x(u, v), f06_y(u, v), f06_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f07_x(u, v), f07_y(u, v), f07_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f08_x(u, v), f08_y(u, v), f08_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f09_x(u, v), f09_y(u, v), f09_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f10_x(u, v), f10_y(u, v), f10_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f11_x(u, v), f11_y(u, v), f11_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f12_x(u, v), f12_y(u, v), f12_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f13_x(u, v), f13_y(u, v), f13_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f14_x(u, v), f14_y(u, v), f14_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f15_x(u, v), f15_y(u, v), f15_z(u, v), u, u_0, u_1, v, v_0, v_1),
    parametric_surface(f16_x(u, v), f16_y(u, v), f16_z(u, v), u, u_0, u_1, v, v_0, v_1)
);
```

(%t66)



(%o66)