Interesting Surfaces

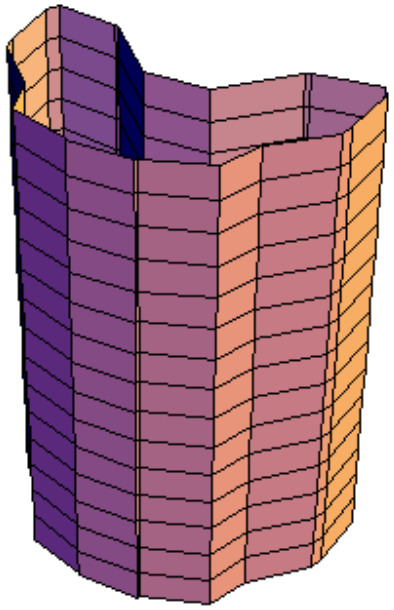
Algebraic and parametric surfaces introduced in "http://www.uib.no/People/nfytn/mathgal.htm" are drawn using *Mathematica* 4.2

```
<< Graphics`ParametricPlot3D`

<< ImplicitPlot3D`
 (* A package developed by Prof. Steven Wilkinson of
   Nothern Kentucky University *)
```

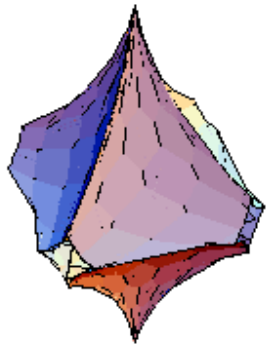
Algebraic Cylinders

```
ImplicitPlot3D[2 x^4 - 3 x^2 y + y^2 - 2 y^3 + y^4 == 0, {x, -4, 4},
 {y, -4, 4}, {z, -2, 2}, Boxed → False];
```



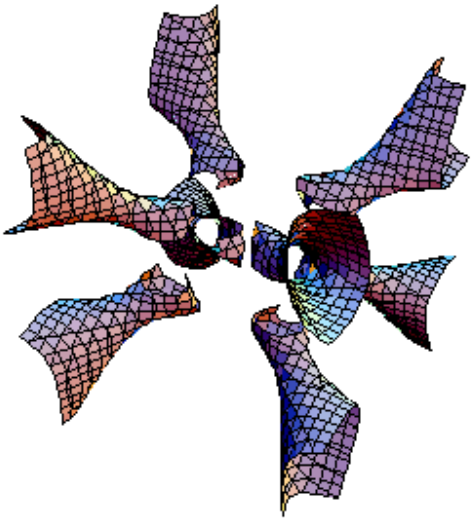
Astrodal Ellipsoid

```
a = 1; b = 1; c = 1;
ParametricPlot3D[{(a Cos[u] Cos[v])^3, (a Sin[u] Cos[v])^3,
   (c Sin[v])^3}, {u, -π, π}, {v, -π, π}, Boxed → False,
 Axes → False];
```



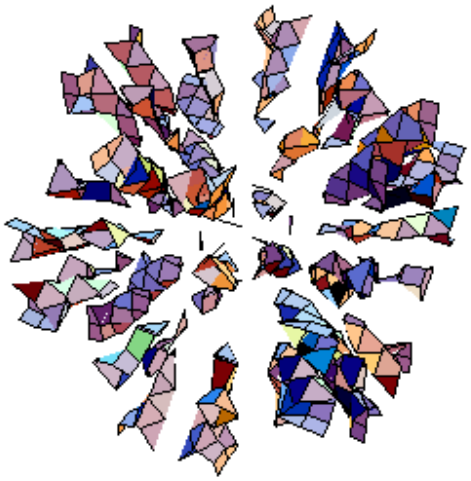
Barth Sextic

```
t = 0.5 (1 + √5);
ImplicitPlot3D[
 4 (t^2 x^2 - y^2) (t^2 y^2 - z^2) (t^2 z^2 - z^2) - (1 + 2 t) (x^2 + y^2 + z^2 - 1)^2 == 0,
 {x, -2, 2}, {y, -2, 2}, {z, -2, 2}, PlotPoints → 30,
 Boxed → False];
```



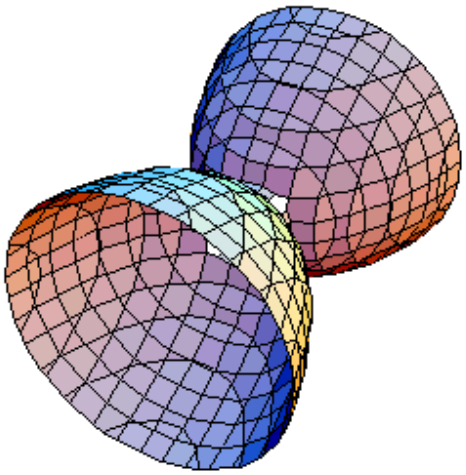
Barth Decic

```
t = 0.5 (1 + √5); w = 1;
ImplicitPlot3D[
 8 (x^2 - t^4 y^2) (y^2 - t^4 z^2) (z^2 - t^4 x^2)
     (x^4 + y^4 + z^4 - 2 x^2 y^2 - 2 x^2 z^2 - 2 y^2 z^2) +
    (3 + 5 t) (x^2 + y^2 + z^2 - w^2)^2 (x^2 + y^2 + z^2 - (2 - t) w^2)^2 == 0,
 {x, -4, 4}, {y, -4, 4}, {z, -4, 4}, Boxed → False];
```



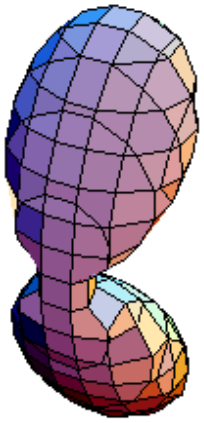
Bicorn

```
ImplicitPlot3D[y^2 (1 - (x^2 + z^2)) - (x^2 + z^2)^2 == 0, {x, -1, 1},
 {y, -1, 1}, {z, -1, 1}, Boxed → False];
```



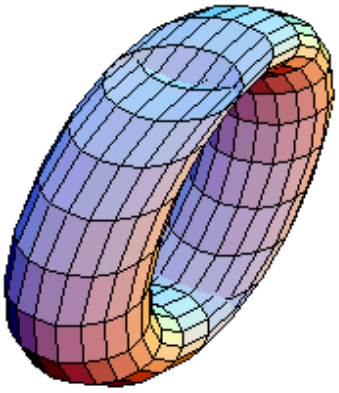
Bifolia

```
a = 3;
ImplicitPlot3D[(x^2 + y^2 + z^2)^2 - a (z^2 + z^2) y == 0, {x, -2, 2},
 {y, -2, 2}, {z, -2, 2}, Boxed → False];
```



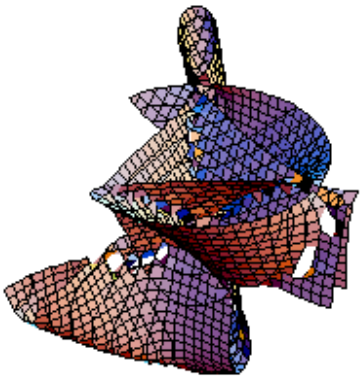
Bohemian Dome

```
a = 0.5; b = 1.5; c = 1;
ParametricPlot3D[{a Cos[u], b Cos[v] + a Sin[u], c Sin[v]},
 {u, 0, 2 π}, {v, 0, 2 π}, Boxed → False, Axes → False];
```



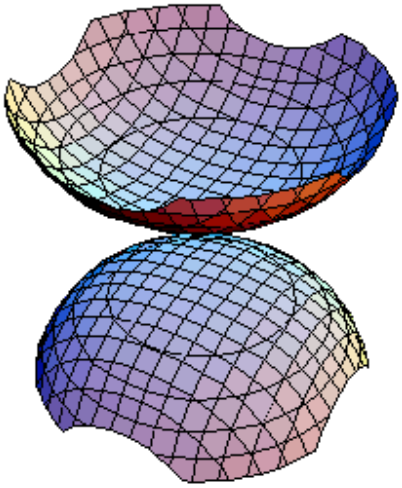
Boy Surface

```
ImplicitPlot3D[
 64 (1 - z)^3 z^3 - 48 (1 - z)^2 z^2 (3 x^2 + 3 y^2 + 2 z^2) +
   12 (1 - z) z
    (27 (x^2 + y^2)^2 - 24 z^2 (x^2 + y^2) + 36 √2 y z (y^2 - 3 x^2) + 4 z^4) +
   (9 x^2 + 9 y^2 - 2 z^2)
    (-81 (x^2 + y^2)^2 - 72 z^2 (x^2 + y^2) + 108 √2 x z (x^2 - 3 y^2) + 4 z^4) == 0,
 {x, -1, 1}, {y, -1, 1}, {z, -1, 1}, Boxed → False,
 PlotPoints → 50];
```



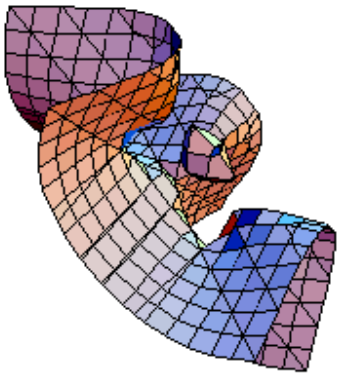
Cassini Ovals

```
a = 0.45; b = 0.5; c = 16;
ImplicitPlot3D[(x^2 + y^2 + z^2 + a^2)^2 - c a^2 (z^2 + z^2 - b^2) == 0,
 {x, -1, 1}, {y, -1, 1}, {z, -1, 1}, Boxed → False];
```



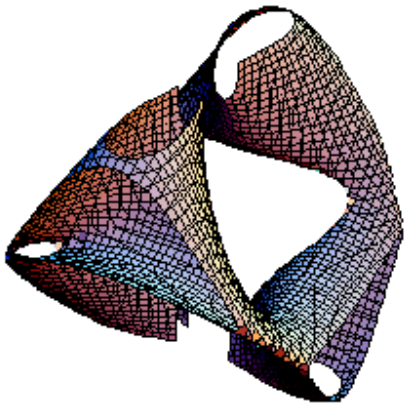
Cayley cubic

```
ImplicitPlot3D[
 -5 (x^2 y + x^2 z + y^2 x + y^2 z + z^2 y + z^2 x) + 2 (x y + x z + y z) == 0,
 {x, -1, 1}, {y, -1, 1}, {z, -1, 1}, Boxed → False];
```



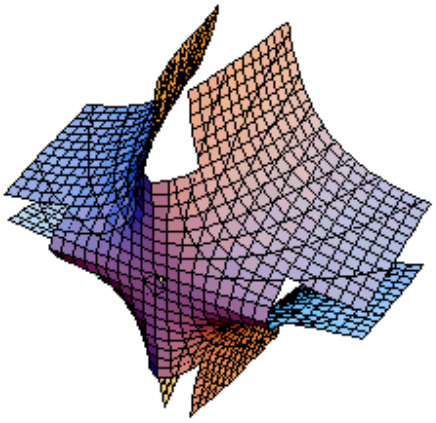
Chair

```
k = 5; a = 0.95; b = 0.8;
ImplicitPlot3D[
 (x^2 + y^2 + z^2 - a k^2)^2 - b ((z - k)^2 - 2 x^2) ((z + k)^2 - 2 y^2) == 0,
 {x, -4, 4}, {y, -4, 4}, {z, -4, 4}, Boxed → False,
 PlotPoints → 40];
```



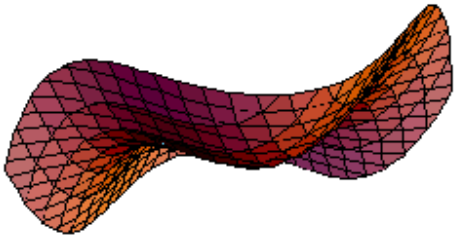
Crossed Trough

```
ImplicitPlot3D[x^2 z^2 - y == 0, {x, -3, 3}, {y, -3, 3}, {z, -3, 3},
 Boxed → False, PlotPoints → 30];
```



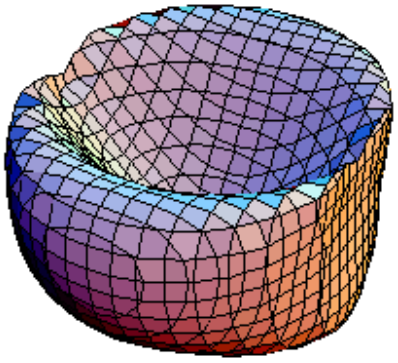
Cuibic Saddle

```
ImplicitPlot3D[x^3 - y^3 - z == 0, {x, -1, 1}, {y, -1, 1},
 {z, -1, 1}, Boxed → False];
```



Cushion

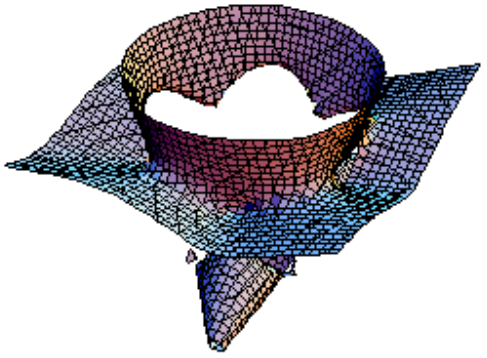
```
ImplicitPlot3D[
 z^2 x^2 - z^4 - 2 z x^2 + 2 z^3 + x^2 - z^2 - (x^2 - z)^2 - y^4 - 2 x^2 y^2 - y^2 z^2 +
   2 y^2 z + y^2 == 0, {x, -4, 4}, {y, -3, 3}, {z, -4, 4},
 Boxed → False, PlotPoints → 60];
```



Dervish

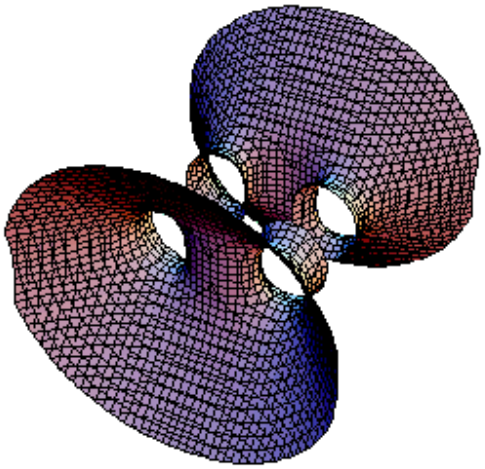
$$a = \frac{1}{5}(-8)\left(1+\frac{1}{\sqrt{5}}\right)\sqrt{5-\sqrt{5}}\;;\; c = \frac{\sqrt{5-\sqrt{5}}}{2};$$

```
ImplicitPlot3D[
 a (x - z) (Cos[2 π/5] x - Sin[2 π/5] y - z) (Cos[4 π/5] x - Sin[4 π/5] y - z)
    (Cos[6 π/5] x - Sin[6 π/5] y - z) (Cos[8 π/5] x - Sin[8 π/5] y - z) +
   (1 - c z) (x^2 + y^2 - 1 + 1/4 (1 + 3 Sqrt[5]) z^2)^2 == 0, {x, -2, 2},
 {y, -2, 2}, {z, -2, 2}, Boxed → False, PlotPoints → 40];
```



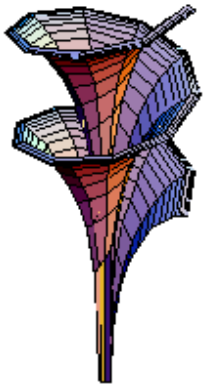
Devil's Curve Variant

```
ImplicitPlot3D[x^4 + 2 x^2 z^2 - 0.36 x^2 - y^4 + 0.25 y^2 + z^4 == 0,
 {x, -1, 1}, {y, -1, 1}, {z, -1, 1}, Boxed → False,
 PlotPoints → 40];
```



Dini's Surface

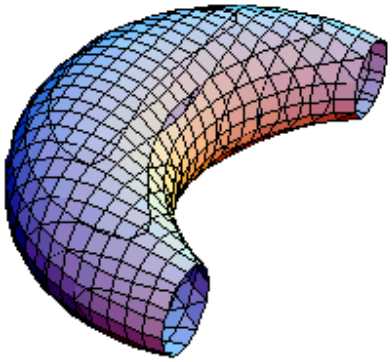
```
a = 1; b = 0.2;
ParametricPlot3D[{a Cos[u] Sin[v], a Sin[u] Sin[v],
   a (Cos[v] + Log[Tan[v/2]]) + b u}, {u, 0, 4 π}, {v, 0.001, 2},
 Boxed → False, Axes → False];
```



Dupin Cyclid

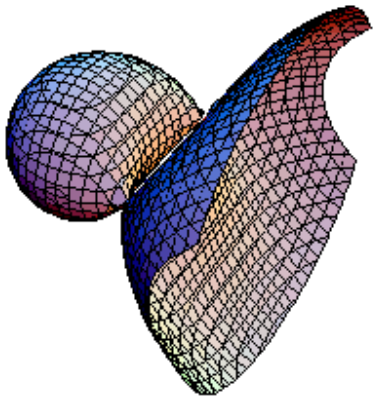
double crescent

```
r0 = 4.9; r1 = 5; dx = 2; dy = 0; ri = 3;
ImplicitPlot3D[
 (r1^2 - dy^2 - (dx + r0)^2) (r1^2 - dy^2 - (dx - r0)^2) (x^4 + y^4 + z^4) +
   2 (r1^2 - dy^2 - (dx + r0)^2) (r1^2 - dy^2 - (dx - r0)^2) (x^2 y^2 + x^2 z^2 + y^2 z^2) +
   2 ri^2 ((-dy^2 - dx^2 + r1^2 + r0^2) (2 x dx + 2 y dy - ri^2) - 4 dy r0^2 y)
    (x^2 + y^2 + z^2) + 4 ri^4 (dx x + dy y) (-ri^2 + dy y + dx x) +
   4 ri^4 r0^2 y^2 + ri^8 == 0, {x, -3, 3}, {y, -3, 3}, {z, -3, 3},
 Boxed → False, PlotPoints → 30];
```



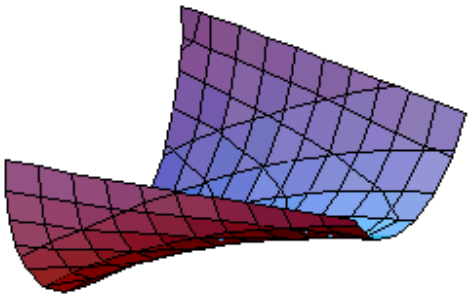
degenerate w.arch

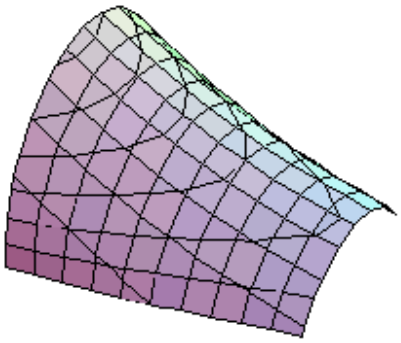
```
r0 = 3; r1 = 5; dx = 3; dy = 0; ri = 9;
ImplicitPlot3D[
 (r1^2 - dy^2 - (dx + r0)^2) (r1^2 - dy^2 - (dx - r0)^2) (x^4 + y^4 + z^4) +
   2 (r1^2 - dy^2 - (dx + r0)^2) (r1^2 - dy^2 - (dx - r0)^2) (x^2 y^2 + x^2 z^2 + y^2 z^2) +
   2 ri^2 ((-dy^2 - dx^2 + r1^2 + r0^2) (2 x dx + 2 y dy - ri^2) - 4 dy r0^2 y)
    (x^2 + y^2 + z^2) + 4 ri^4 (dx x + dy y) (-ri^2 + dy y + dx x) +
   4 ri^4 r0^2 y^2 + ri^8 == 0, {x, -30, 30}, {y, -30, 30}, {z, -30, 30},
 Boxed → False, PlotPoints → 30];
```



plain

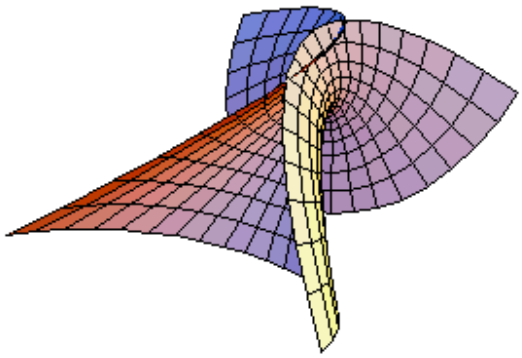
```
r0 = 6; r1 = 0.5; dx = 3; dy = 0; ri = 12;
ImplicitPlot3D[
 (r1^2 - dy^2 - (dx + r0)^2) (r1^2 - dy^2 - (dx - r0)^2) (x^4 + y^4 + z^4) +
   2 (r1^2 - dy^2 - (dx + r0)^2) (r1^2 - dy^2 - (dx - r0)^2) (x^2 y^2 + x^2 z^2 + y^2 z^2) +
   2 ri^2 ((-dy^2 - dx^2 + r1^2 + r0^2) (2 x dx + 2 y dy - ri^2) - 4 dy r0^2 y)
    (x^2 + y^2 + z^2) + 4 ri^4 (dx x + dy y) (-ri^2 + dy y + dx x) +
   4 ri^4 r0^2 y^2 + ri^8 == 0, {x, -30, 30}, {y, -50, 20}, {z, -30, 30},
 Boxed → False, PlotPoints -> 50];
```





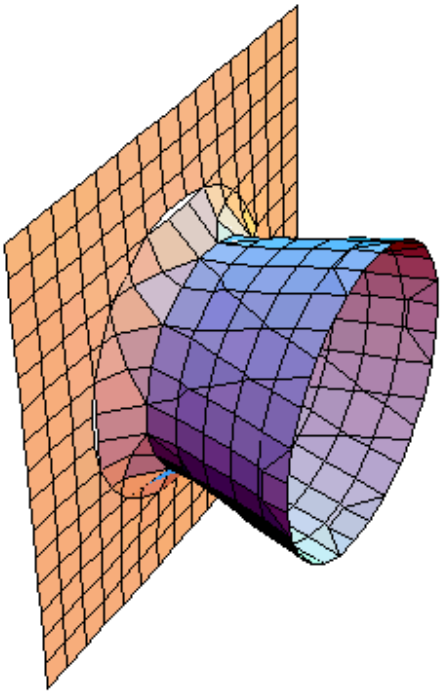
Ennepers Surface

$$\texttt{ParametricPlot3D}\left[\left\{u - \frac{u^3}{3} + u\,v^2,\ v - \frac{v^3}{v} + u^2\,v,\ u^2 - v^2\right\},\right.$$
$$\left.\{u,\ -2,\ 2\},\ \{v,\ -2,\ 2\},\ \texttt{Boxed} \to \texttt{False},\ \texttt{Axes} \to \texttt{False}\right];$$



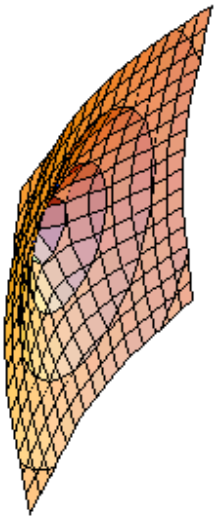
Folium Surface

```
a = 1; b = 1;
ImplicitPlot3D[(y^2 + z^2) (1 + (b - 4 a) x) + x^2 (1 + b) == 0,
 {x, -2, 2}, {y, -2, 2}, {z, -2, 2}, Boxed → False];
```



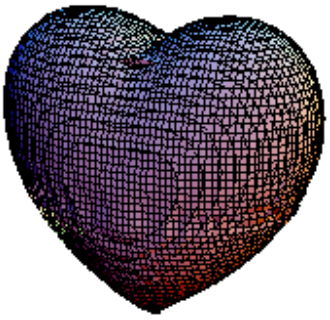
Glob

```
ImplicitPlot3D[0.5 x^5 + 0.5 x^4 - (y^2 + z^2) == 0, {x, -2, 2},
 {y, -2, 2}, {z, -2, 2}, Boxed → False];
```



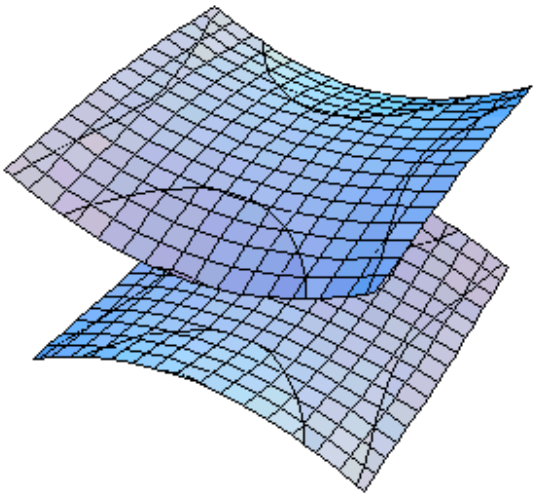
Heart

```
ImplicitPlot3D[(2 x^2 + y^2 + z^2 - 1)^3 - x^2 z^3/10 - y^2 z^3 == 0, {x, -2, 2},
 {y, -2, 2}, {z, -2, 3}, Boxed → False, PlotPoints → 100,
 ViewPoint → {2.5, 1, 1}];
```



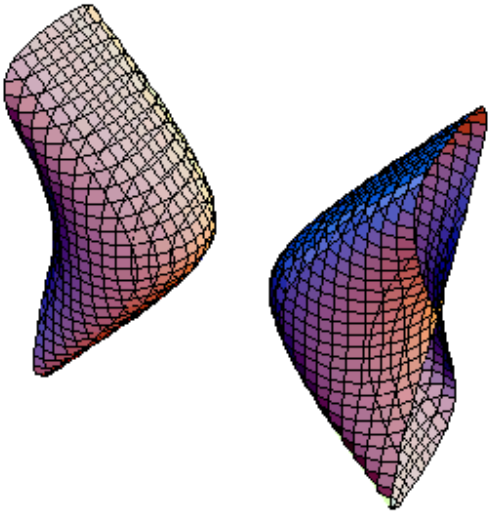
Hunt Surface

```
ImplicitPlot3D[4 (x^2 + y^2 + z^2 - 13)^3 + 27 (3 x^2 + y^2 - 4 z^2 - 12)^2 == 0,
 {x, -2, 2}, {y, -2, 2}, {z, -2, 2}, Boxed → False];
```



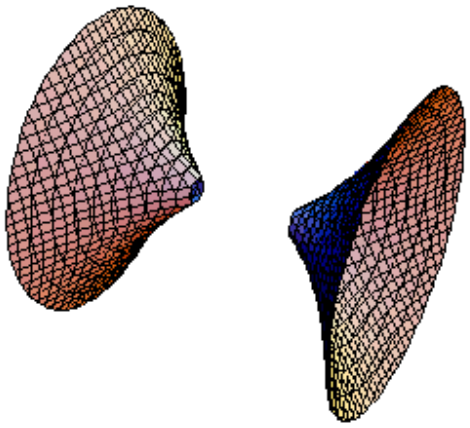
Hyperbolic Torus

```
r0 = 0.6; r1 = 0.4;
ImplicitPlot3D[
 x^4 + 2 x^2 y^2 - 2 x^2 z^2 - 2 (r0^2 + r1^2) x^2 + y^4 - 2 y^2 z^2 + 2 (r0^2 - r1^2) y^2 +
   z^4 + 2 (r0^2 + r1^2) z^2 + (r0^2 - r1^2)^2 == 0, {x, -1, 1}, {y, -1, 1},
 {z, -1, 1}, Boxed → False, PlotPoints → 30];
```



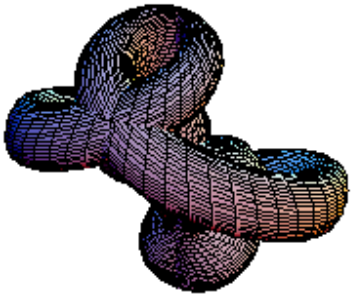
Kampyle of Eudoxus

```
a = 0.2; c = 1;
ImplicitPlot3D[(y^2 + z^2) - c^2 x^4 + c^2 a^2 x^2 == 0, {x, -1, 1},
 {y, -1, 1}, {z, -1, 1}, Boxed → False, PlotPoints → 30];
```

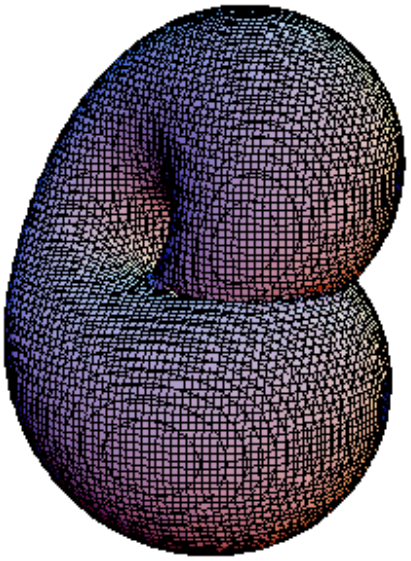


Kline Bottle

```
ParametricPlot3D[{Cos[u] (Cos[u/2] (Sqrt[2] + Cos[v]) + Sin[u/2] Sin[v] Cos[v]),
  Sin[u] (Cos[u/2] (Sqrt[2] + Cos[v]) + Sin[u/2] Sin[v] Cos[v]),
  -Sin[u/2] (Sqrt[2] + Cos[v]) + Cos[u/2] Sin[v] Cos[v]}, {u, 0, 4 Pi}, {v, 0, 2 Pi},
 Boxed -> False, Axes -> False, PlotPoints -> 100];
```

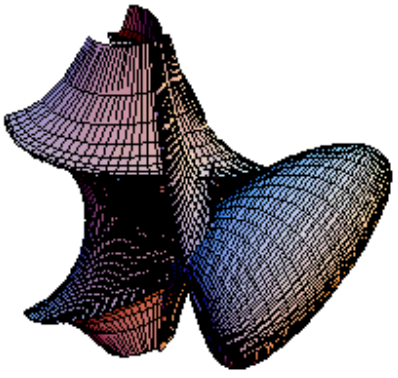


```
ImplicitPlot3D[
  (x^2 + y^2 + z^2 + 2 y - 1) ((x^2 + y^2 + z^2 - 2 y - 1)^2 - 8 z^2) +
    16 x z (x^2 + y^2 + z^2 - 2 y - 1) == 0, {x, -5, 5}, {y, -5, 5},
  {z, -5, 5}, Boxed -> False, PlotPoints -> 100, ViewPoint -> {4, 1, 1}];
```



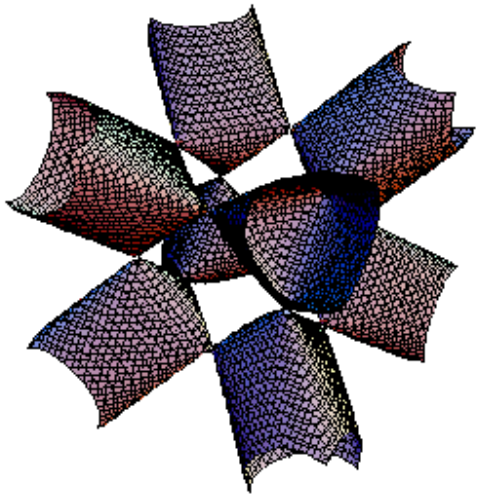
Kuen's Surface

```
ParametricPlot3D[{2 (Cos[u] + u Sin[u]) Sin[v] / (1 + u^2 Sin[v]^2),
  2 (Sin[u] + u Cos[u]) Sin[v] / (1 + u^2 Sin[v]^2), Log[Tan[v/2]] + 2 Cos[v] / (1 + u^2 Sin[v]^2)},
 {u, -4, 4}, {v, 0.05, π - 0.05}, Boxed → False, Axes → False,
 PlotPoints → 100];
```



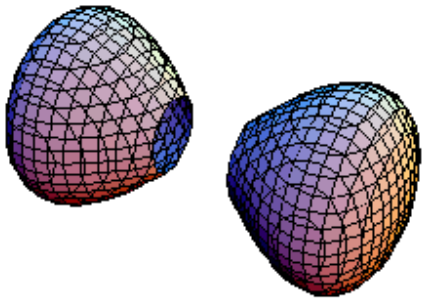
Kummer Surface

```
ImplicitPlot3D[x^4 + y^4 + z^4 - x^2 - y^2 - z^2 - x^2 y^2 - x^2 z^2 - y^2 z^2 + 1 == 0,
 {x, -2, 2}, {y, -2, 2}, {z, -2, 2}, Boxed → False,
 PlotPoints → 50];
```



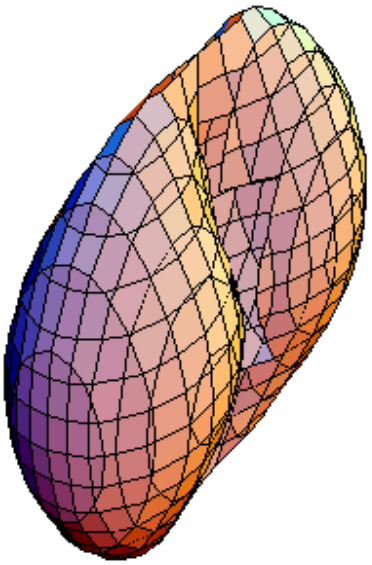
Lemniscate of Gerono, or Eight Curve

```
ImplicitPlot3D[x^4 - x^2 + y^2 + z^2 == 0, {x, -1, 1}, {y, -1, 1},
 {z, -1, 1}, Boxed → False, PlotPoints → 30];
```



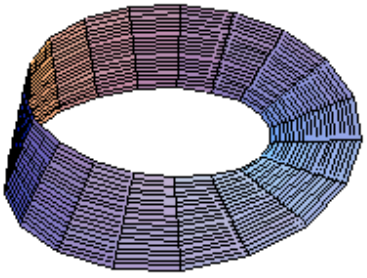
Mitre Surface

```
ImplicitPlot3D[4 x^2 (x^2 + y^2 + z^2) - y^2 (1 - y^2 - z^2) == 0, {x, -1, 1},
 {y, -2, 2}, {z, -2, 2}, Boxed → False, PlotPoints → 30];
```



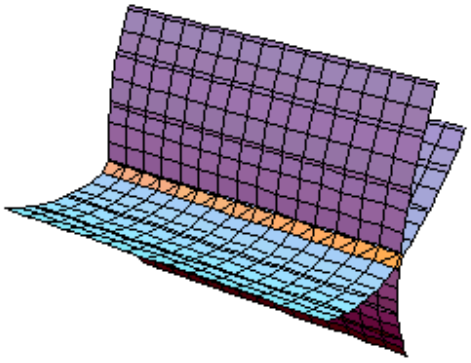
Moebius Strip

```
ParametricPlot3D[{Cos[u] + v Cos[u/2] Cos[u],
  Sin[u] + v Cos[u/2] Sin[u], v Sin[u/2]}, {u, 0, 2 π},
 {v, -0.3, 0.3}, Boxed → False, Axes → False];
```



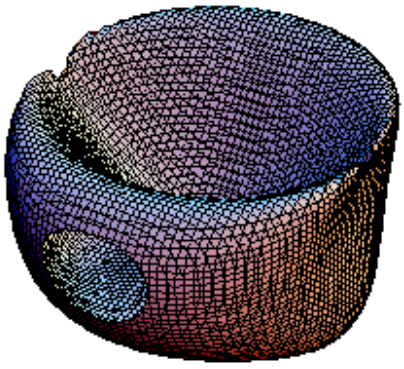
Nodal_Cubic

```
ImplicitPlot3D[y^3 + z^3 - 6 y z == 0, {x, -2, 2}, {y, -2, 2},
 {z, -2, 2}, Boxed → False];
```



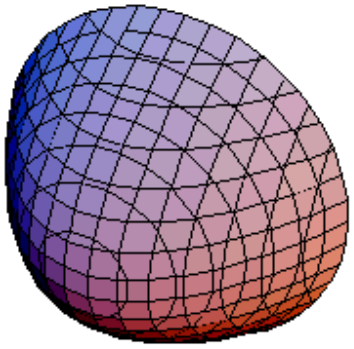
Odd Surface

```
ImplicitPlot3D[
 z^2 x^2 - z^4 - 2 z x^2 + 2 z^3 + x^2 - z^2 - (x^2 - z)^2 - y^4 - 2 y^2 x^2 - y^2 z^2 +
   2 y^2 z + y^2 == 0, {x, -2, 2}, {y, -2, 2}, {z, -2, 2},
 Boxed → False, PlotPoints → 100];
```



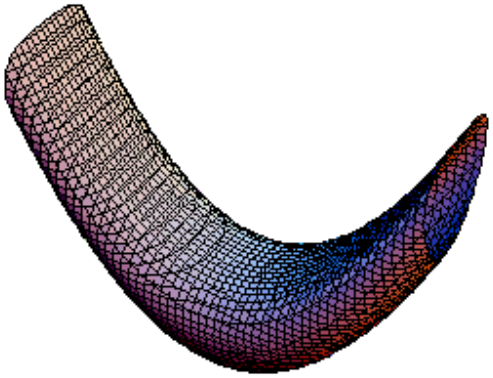
Paraboloid

```
ImplicitPlot3D[x^2 - y + z^2 == 0, {x, -1, 1}, {y, -1, 1},
 {z, -1, 1}, Boxed → False];
```



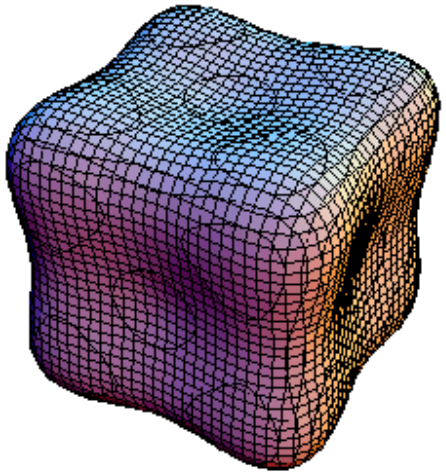
Parabolic Torus

```
r0 = 0.6; r1 = 0.5;
ImplicitPlot3D[
 x^4 + 2 x^2 y^2 - 2 x^2 z - (r0^2 + r1^2) x^2 + y^4 - 2 y^2 z + (r0^2 - r1^2) y^2 +
   z^2 + (r0^2 + r1^2) z + (r0^2 - r1^2)^2 == 0, {x, -1, 1}, {y, -1, 1},
 {z, -1, 1}, Boxed → False, PlotPoints → 50];
```



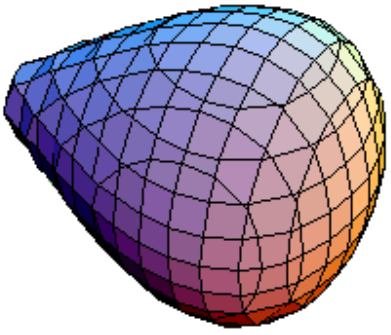
Pillow/Tooth Object

```
ImplicitPlot3D[x^4 + y^4 + z^4 - (x^2 + y^2 + z^2) == 0, {x, -2, 2},
 {y, -2, 2}, {z, -2, 2}, Boxed → False, PlotPoints → 50];
```



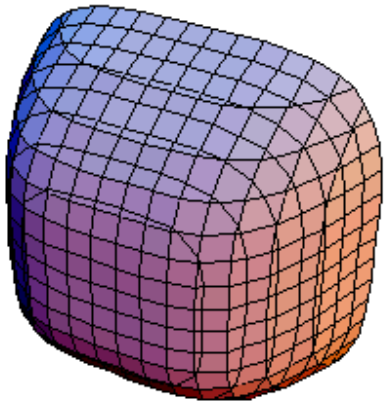
Piriform

```
ImplicitPlot3D[(x^4 - x^3) + y^2 + z^2 == 0, {x, -1, 1}, {y, -1, 1},
 {z, -1, 1}, Boxed → False, PlotPoints → 30];
```



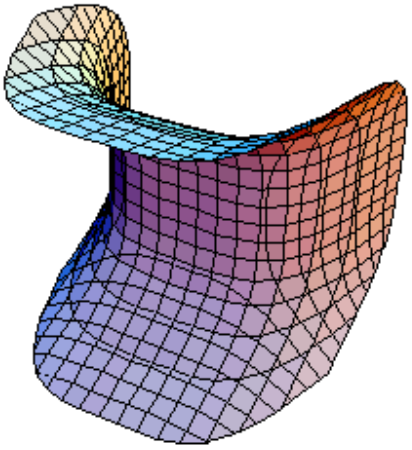
Quartic Paraboloid

```
ImplicitPlot3D[x^4 + z^4 - y == 0, {x, -1, 1}, {y, -1, 1},
 {z, -1, 1}, Boxed → False];
```



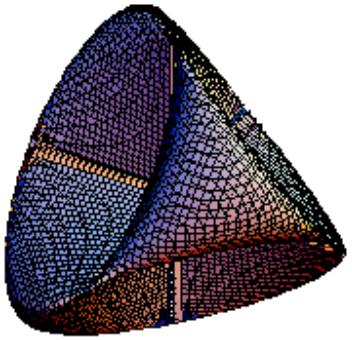
Quartic Saddle

```
ImplicitPlot3D[x^4 - z^4 - y == 0, {x, -1, 1}, {y, -1, 1},
 {z, -1, 1}, Boxed → False];
```



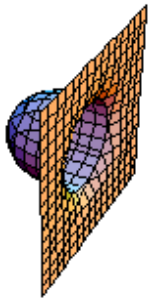
Steiners Roman Surface

```
ImplicitPlot3D[x^2 y^2 + x^2 z^2 + y^2 z^2 + x y z == 0, {x, -1, 1},
 {y, -1, 1}, {z, -1, 1}, Boxed → False, PlotPoints → 100];
```



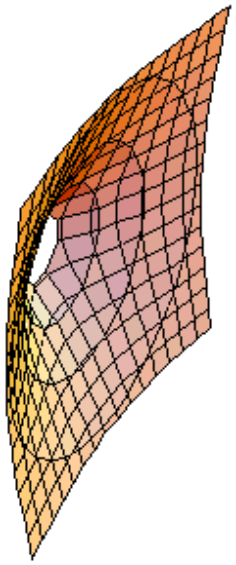
Strophoid

```
a = 1; b = -0.1; c = 0.8;
ImplicitPlot3D[(b - x) (y^2 + z^2) - c^2 a x^2 - c^2 x^3 == 0, {x, -1, 1},
 {y, -1, 1}, {z, -1, 1}, Boxed → False];
```



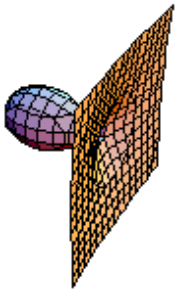
Right Strophoid

```
a = 1; b = 1; c = 0.8;
ImplicitPlot3D[(b - x) (y^2 + z^2) - c^2 a x^2 - c^2 x^3 == 0, {x, -1, 1},
 {y, -1, 1}, {z, -1, 1}, Boxed → False];
```



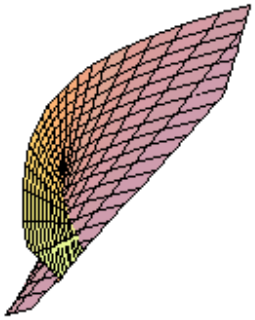
Trisectrix of Maclaurin

```
a = 1; b = 1/3; c = 0.8;
ImplicitPlot3D[(b - x) (y^2 + z^2) - c^2 a x^2 - c^2 x^3 == 0, {x, -1, 1},
 {y, -1, 1}, {z, -1, 1}, Boxed → False];
```



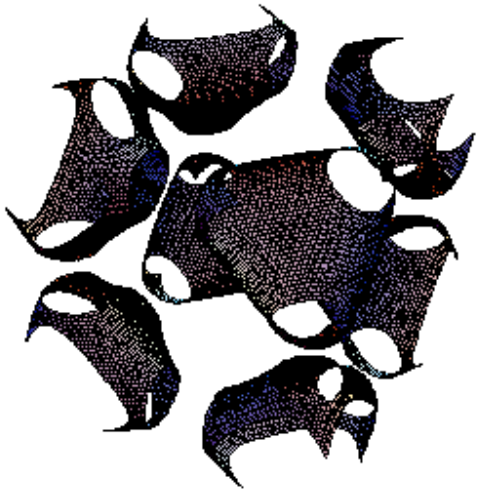
Swallowtail

```
ParametricPlot3D[{u v^2 + 3 v^4, -2 u v - 4 v^3, u}, {u, -2, 2},
 {v, -0.8, 0.8}, Boxed → False, Axes → False];
```



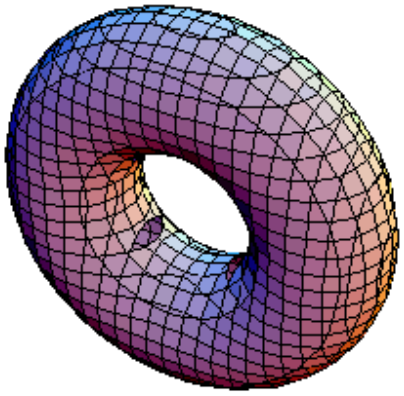
Tangle

```
ImplicitPlot3D[x^4 - 5 x^2 + y^4 - 5 y^2 + z^4 - 5 z^2 + 11.8 == 0,
 {x, -2, 2}, {y, -2, 2}, {z, -2, 2}, Boxed → False,
 PlotPoints → 100];
```



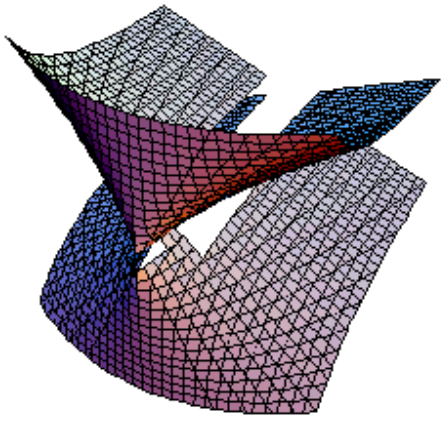
Torus

```
r0 = 1; r1 = 0.5;
ImplicitPlot3D[
 x^4 + y^4 + z^4 + 2 x^2 y^2 + 2 x^2 z^2 + 2 y^2 z^2 - 2 (r0^2 + r1^2) x^2 +
   2 (r0^2 - r1^2) y^2 - 2 (r0^2 + r1^2) z^2 + (r0^2 - r1^2)^2 == 0, {x, -2, 2},
 {y, -2, 2}, {z, -2, 2}, Boxed → False, PlotPoints → 30];
```



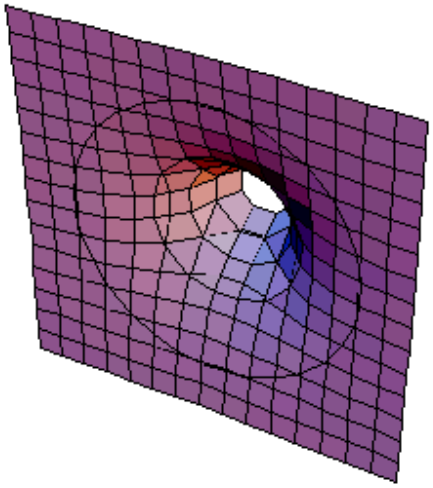
Umblrella

```
ImplicitPlot3D[x^2 - y z^2 == 0, {x, -3, 3}, {y, 0, 6}, {z, -3, 3},
 Boxed → False, PlotPoints → 30];
```



Witch of Agnesi

```
a = 0.04;
ImplicitPlot3D[a (y - 1) + (x^2 + z^2) y == 0, {x, -1, 1},
 {y, -1, 1}, {z, -1, 1}, Boxed → False];
```



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up