Curves and surfaces — Gnuplot

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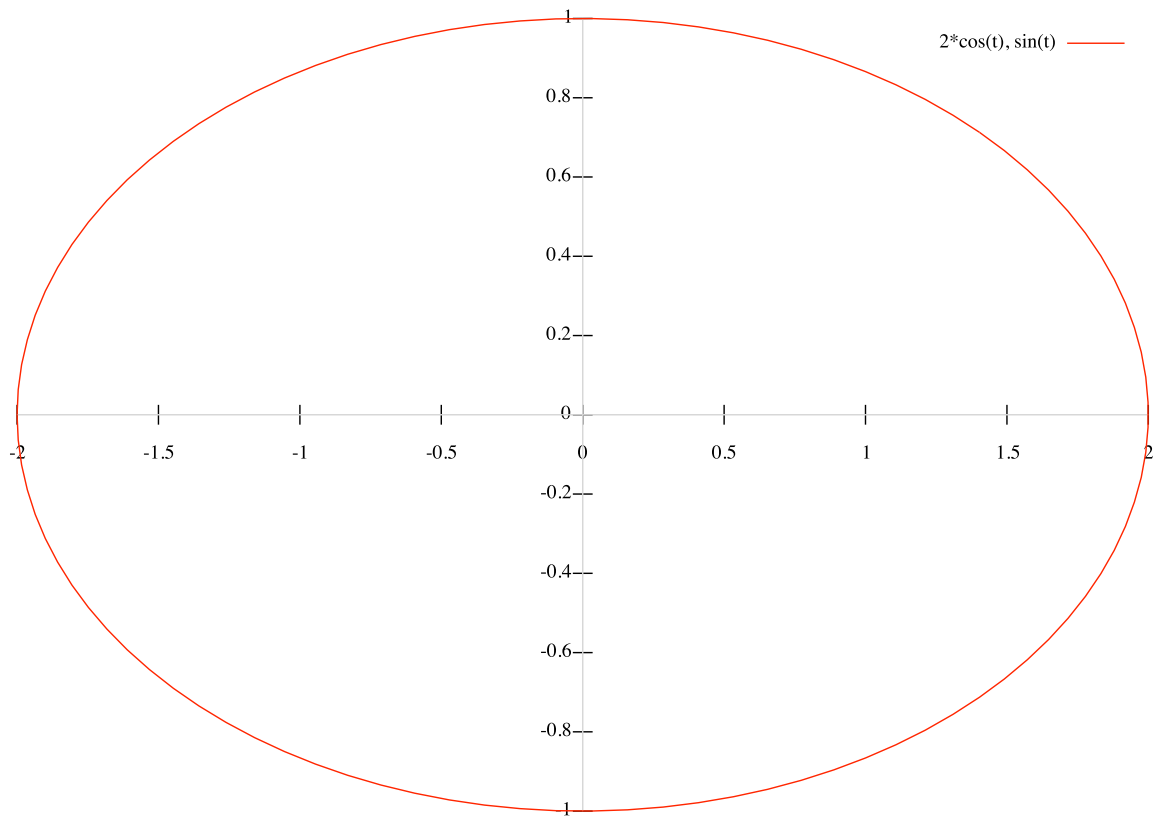
Contents

1 Ellipse

Canonical implicit form:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Canonical parametric form:

$$\begin{cases} x = a \, \cos t \\ y = b \, \sin t \end{cases}, \quad t \in [-\pi, \pi]$$

Gnuplot:

```
gnuplot> set parametric
gnuplot> unset border
gnuplot> set xtics axis
gnuplot> set ytics axis
gnuplot> set xzeroaxis
gnuplot> set yzeroaxis
gnuplot> plot [-pi:pi] 2*cos(t), sin(t)
```
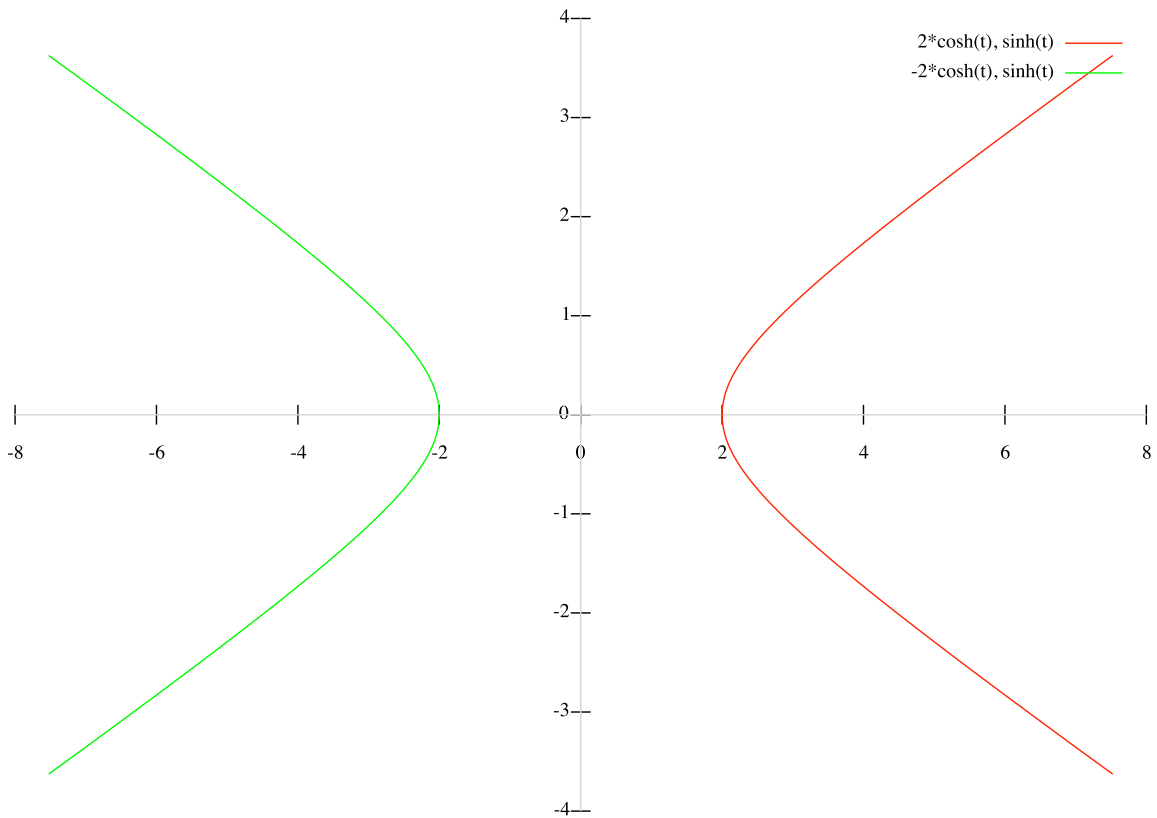
2 Hyperbola

Canonical implicit form:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

Canonical parametric form:

$$\begin{cases} x = \pm a \, \cosh t \\ y = b \, \sinh t \end{cases}, \quad t \in \mathbb{R}$$

Gnuplot:

```
gnuplot> set parametric
gnuplot> unset border
gnuplot> set xtics axis
gnuplot> set ytics axis
gnuplot> set xzeroaxis
gnuplot> set yzeroaxis
gnuplot> plot [-2:2] 2*cosh(t), sinh(t), -2*cosh(t), sinh(t)
```
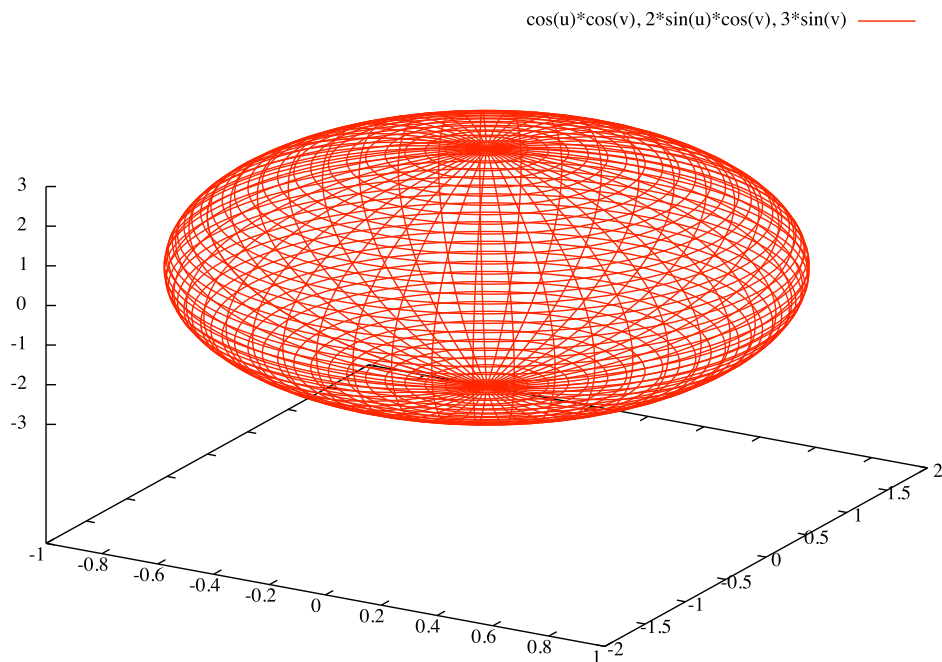
3 Ellipsoid

Canonical implicit form:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$$

Canonical parametric form:

$$\begin{cases} x = a \, \cos u \, \cos v \\ y = b \, \sin u \, \cos v \\ z = c \, \sin v \end{cases} \quad u \in [-\pi, \pi], \quad v \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right].$$

Gnuplot:

```
gnuplot> set parametric
gnuplot> set isosamples 50
gnuplot> splot [-pi:pi][-pi/2:pi/2] cos(u)*cos(v), 2*sin(u)*cos(v), 3*sin(v)
```


cos(u)*cos(v), 2*sin(u)*cos(v), 3*sin(v) ———

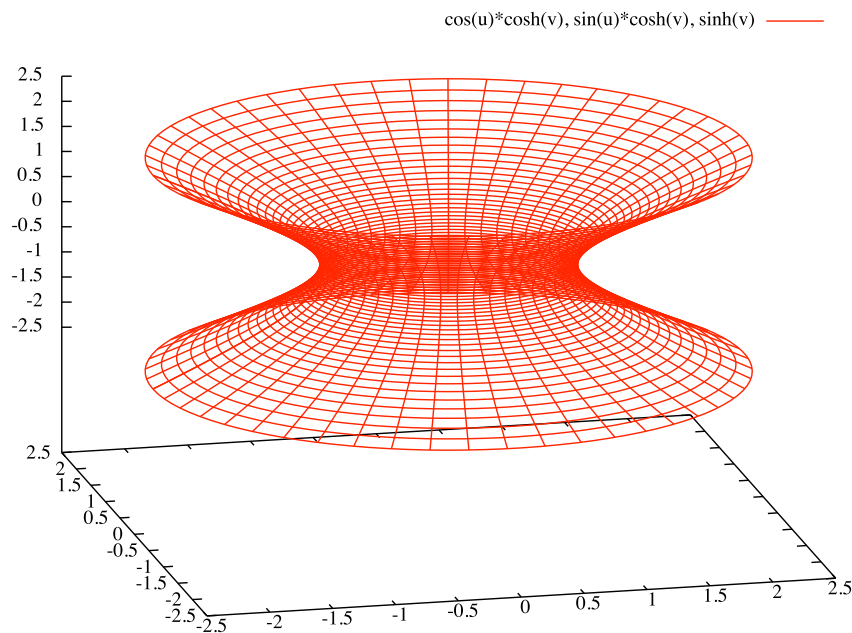# 4   Hyperboloid of one sheet

Canonical implicit form:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1$$

Canonical parametric form:

$$\begin{cases} x = a \, \cos u \, \cosh v \\ y = b \, \sin u \, \cosh v \\ z = c \, \sinh v \end{cases} \quad u \in [-\pi, \pi], \quad v \in \mathbb{R}.$$

Gnuplot:

```
gnuplot> set parametric
gnuplot> set isosamples 50
gnuplot> splot [-pi:pi][-1.5:1.5] cos(u)*cosh(v), sin(u)*cosh(v), sinh(v)
```

5 Hyperboloid of two sheets
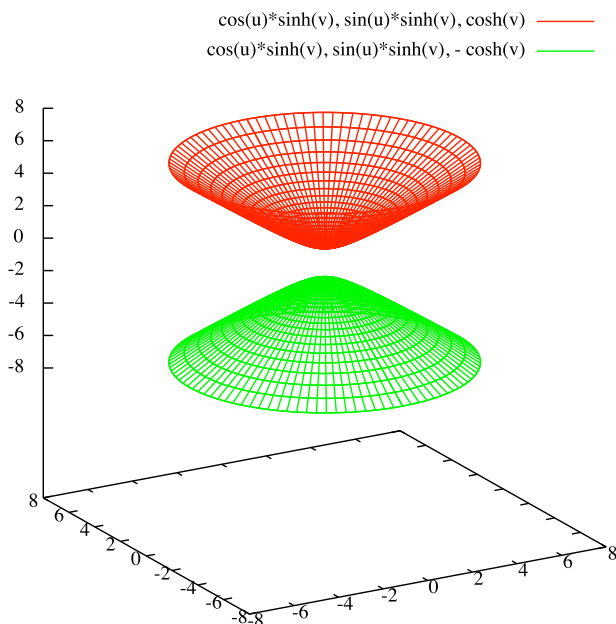
Canonical implicit form:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = -1$$

Canonical parametric form:

$$\begin{cases} x = a \, \cos u \, \sinh v \\ y = b \, \sin u \, \sinh v \\ z = \pm c \, \cosh v \end{cases} \quad u \in [-\pi, \pi], \quad v \in \mathbb{R}_+.$$

Gnuplot:

```
gnuplot> set parametric
gnuplot> set isosamples 50
gnuplot> set view equal
gnuplot> splot [-pi:pi][-2.5:2.5] cos(u)*sinh(v), sin(u)*sinh(v), cosh(v); \
cos(u)*sinh(v), sin(u)*sinh(v), -cosh(v)
```
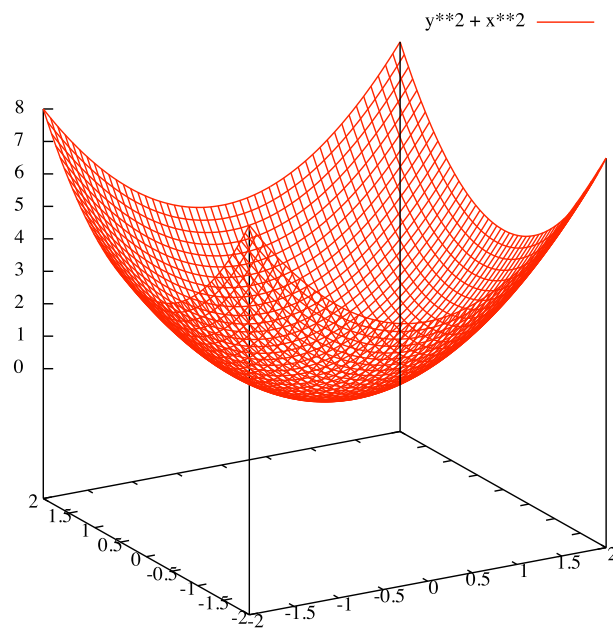
6   Elliptic paraboloid

Elliptic Paraboloid – Google Search

Canonical form:

$$\frac{z}{c} = \frac{y^2}{b^2} + \frac{x^2}{a^2}$$

Gnuplot:

```
gnuplot> splot [-2:2][-2:2] y**2 + x**2
```
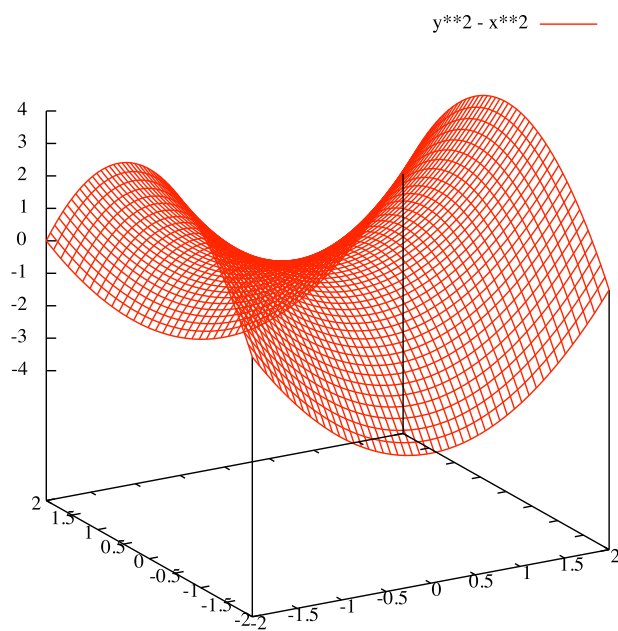
7 Hyperbolic paraboloid

Hyperbolic Paraboloid – Google Search

Canonical form:

$$\frac{z}{c} = \frac{y^2}{b^2} - \frac{x^2}{a^2}$$

Gnuplot:

gnuplot> splot [-2:2][-2:2] y**2 - x**2

8   Elliptic cone

Canonical implicit form:

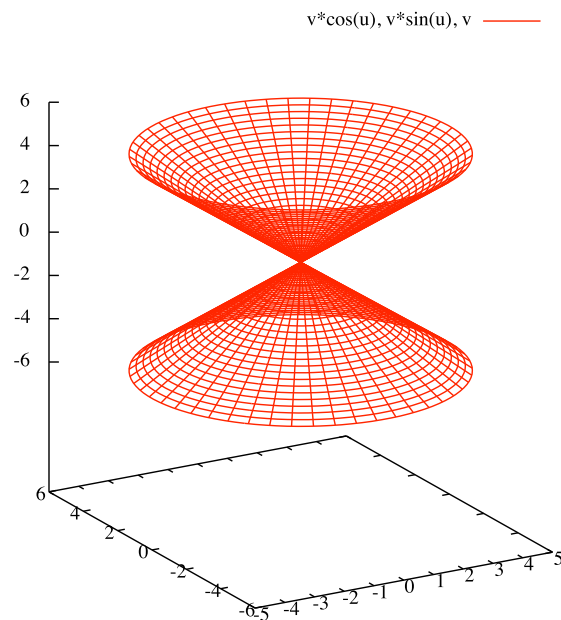$$\frac{z^2}{c^2} = \frac{y^2}{b^2} + \frac{x^2}{a^2}$$

Canonical parametric form:

$$\begin{cases} x = v \cos u \\ y = v \sin u \quad u \in [-\pi, \pi], \quad v \in \mathbb{R}. \\ z = v \end{cases}$$

Gnuplot:

```
gnuplot> set parametric
gnuplot> set isosamples 50
gnuplot> splot [-pi:pi][-5:5] v*cos(u), v*sin(u), v
```

9   Torus

Canonical parametric form:

$$\begin{cases} x = (R + r \cos u) \cos v \\ y = (R + r \cos u) \sin v \quad u, v \in [-\pi, \pi]. \\ z = r \sin u \end{cases}$$

Gnuplot:

```
gnuplot> set parametric
gnuplot> set isosamples 50
gnuplot> splot [-pi:pi][-pi:pi] (5 + cos(u))*cos(v), (5 + cos(u))*sin(v), sin(u)
```