

# Boy's surface

[https://en.wikipedia.org/wiki/Boy%27s\\_surface#Parametrization\\_of\\_Boy's\\_surface](https://en.wikipedia.org/wiki/Boy%27s_surface#Parametrization_of_Boy's_surface)

*restart*

*with(plots) :*

**Parametrisering fra Bryant (WikiPedia):**

( $\|w\| \leq 1$ ),

$$g_1 = -\frac{3}{2} \operatorname{Im} \left[ \frac{w(1-w^4)}{w^6 + \sqrt{5}w^3 - 1} \right]$$

$$g_2 = -\frac{3}{2} \operatorname{Re} \left[ \frac{w(1+w^4)}{w^6 + \sqrt{5}w^3 - 1} \right]$$

$$g_3 = \operatorname{Im} \left[ \frac{1+w^6}{w^6 + \sqrt{5}w^3 - 1} \right] - \frac{1}{2}$$

so that

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \frac{1}{g_1^2 + g_2^2 + g_3^2} \begin{pmatrix} g_1 \\ g_2 \\ g_3 \end{pmatrix}$$

**Implementering af formlerne:**

Parameteren  $w$  skal udfylde enhedscirklen i den komplekse plan.

Dette kan realiseres med  $v \in [0; 1]$  og  $u \in [0; 2 \cdot \pi]$ .

$$w := v \cdot \cos(u) + v \cdot \sin(u) \cdot I:$$

$$N := w^6 + \sqrt{5} \cdot w^3 - 1:$$

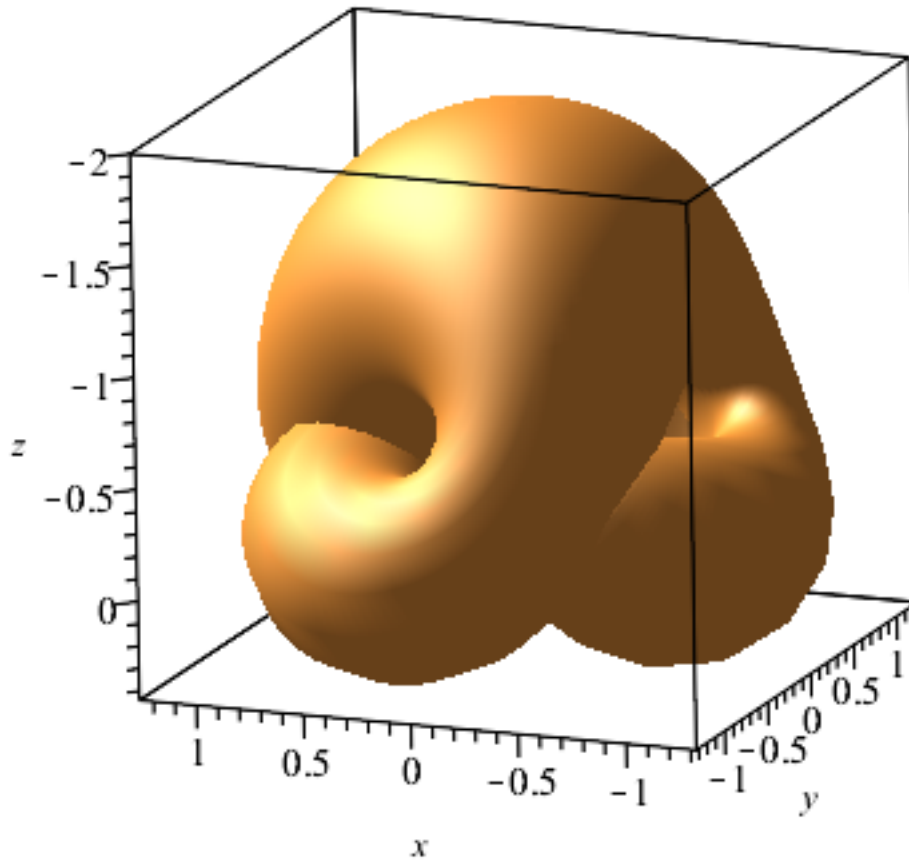
$$g_1 := -\frac{3}{2} \cdot \operatorname{Im} \left( \frac{w \cdot (1 - w^4)}{N} \right):$$

$$g_2 := -\frac{3}{2} \cdot \operatorname{Re} \left( \frac{w \cdot (1 + w^4)}{N} \right):$$

$$g_3 := \operatorname{Im} \left( \frac{1 + w^6}{N} \right) - \frac{1}{2}:$$

$$p(u, v) := \frac{1}{g_1^2 + g_2^2 + g_3^2} \cdot \langle g_1, g_2, g_3 \rangle:$$

```
boy := plot3d(p(u, v), u = 0 .. 2 * pi, v = 0 .. 1, color = gold, labels = [x, y, z], scaling = constrained,  
numpoints = 10000, transparency = 0, style = patchnogrid)
```

**Fremstilling af STL-fil:**

```
Export("boy.stl", boy, base = homedir) = 1000084
```