

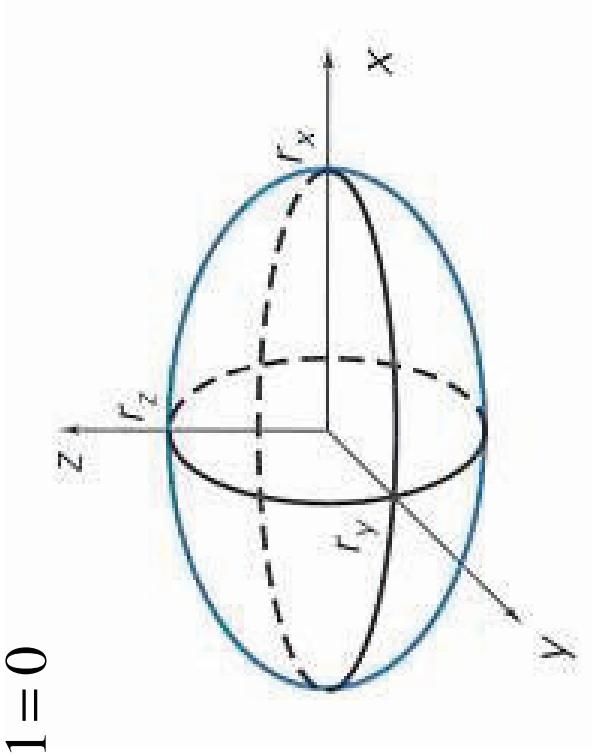
Representações de Superf. Implícitas

- Como se pode definir uma função implícita?
 - Algebricamente
 - "Blobby models"
 - Esqueletos
 - Procedural
 - Amostragem
 -

Superfícies Algébricas

- Função implícita é polinomial
 - $f(x,y,z)=ax^d+by^d+cz^d+dx^{d-1}y+dx^{d-1}z+dy^{d-1}x+\dots$

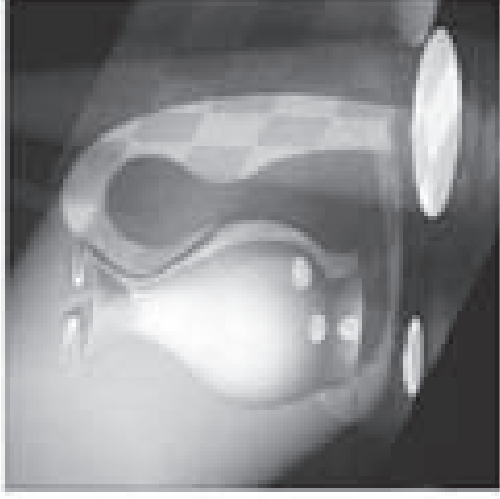
$$\left(\frac{x}{r_x}\right)^2 + \left(\frac{y}{r_y}\right)^2 + \left(\frac{z}{r_z}\right)^2 - 1 = 0$$



H&B Figure 10.10

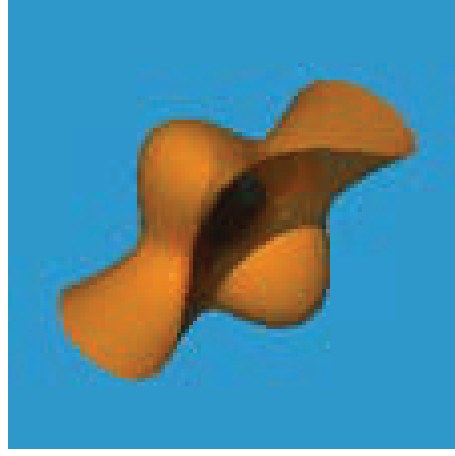
Superfícies Algébricas

- Formas mais comuns: quádricas
 - $f(x,y,z)=ax^2+by^2+cz^2+2dxy+2eyz+2fzx+2gx+2hy+2jz+k$
- Exemplos
 - Esfera
 - Elipsóide
 - Torus
 - Parabolóide
 - Hiperbolóide

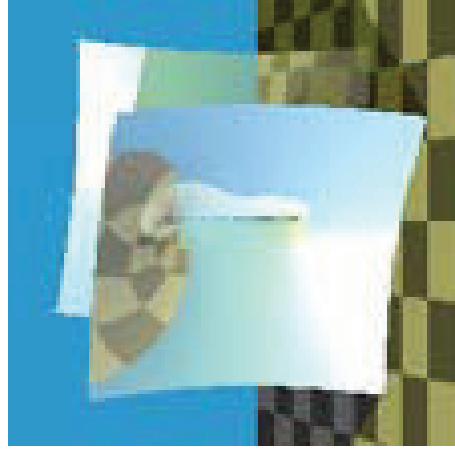


Superfícies Algébricas

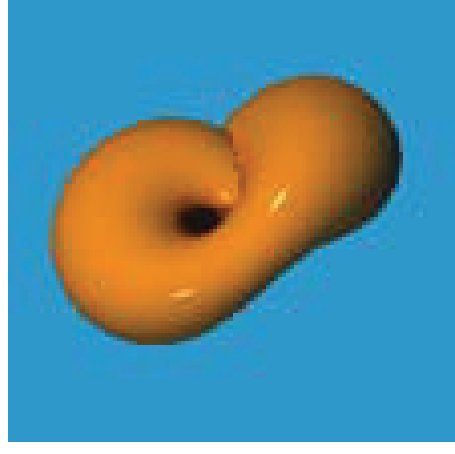
- Superfícies algébricas de graus mais elevados



Cúbica



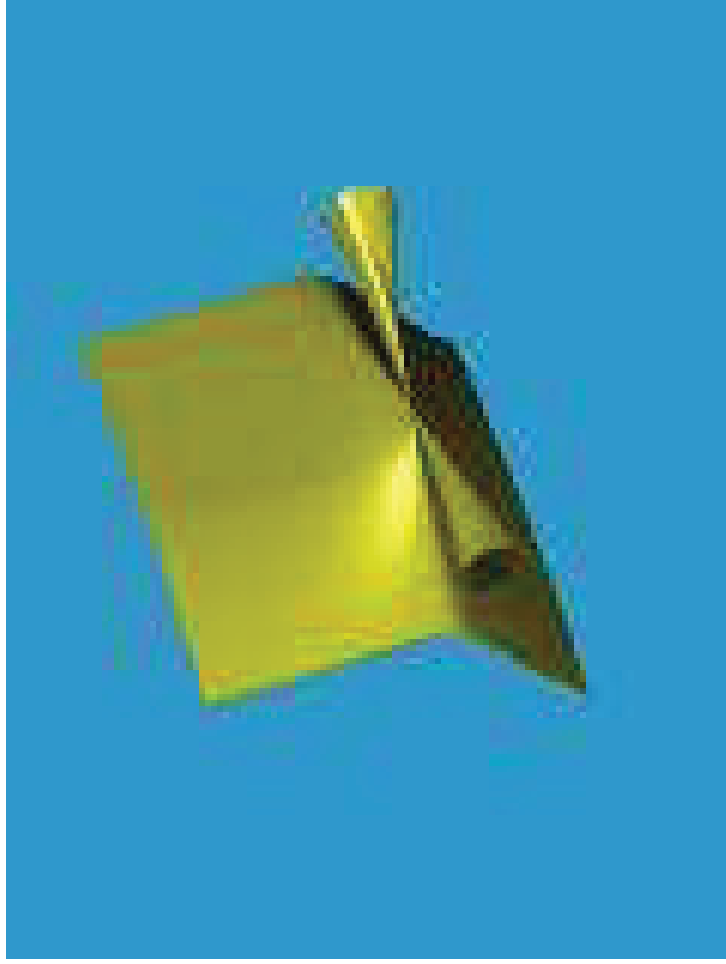
Quártica



Grau seis

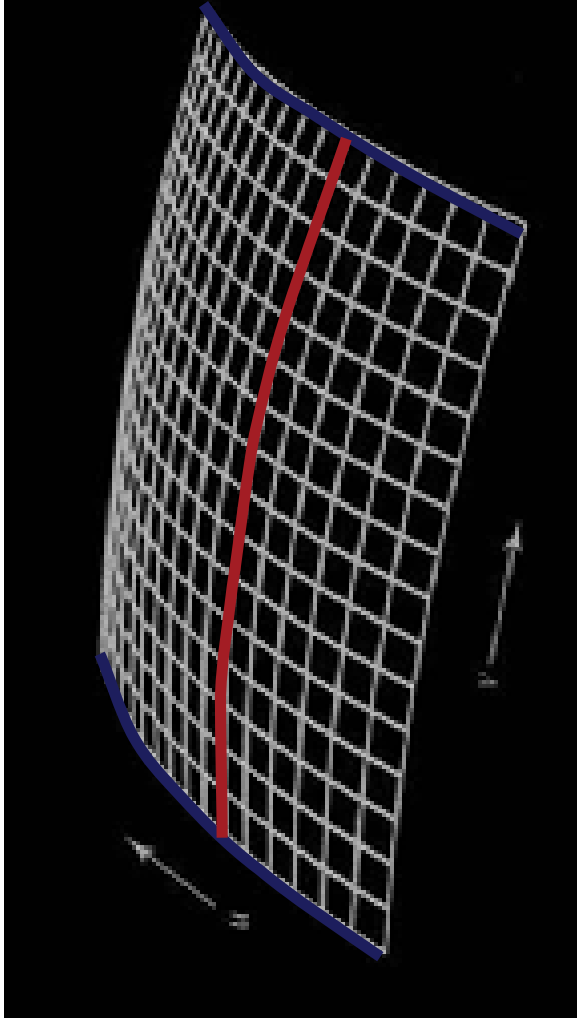
Superfícies Algébricas

- Função pode se estender para infinito
 - Deve-se podar para obter o retalho desejado (isso é difícil!)



Superfícies Algébricas

- Equivalente a superfícies paramétricas
 - Retalho produzido pelo produto tensorial de curvas de grau m e n resulta em função algébrica de grau $2mn$



Retalho bicúbico possui grau igual a 18!

Superfícies Algébricas

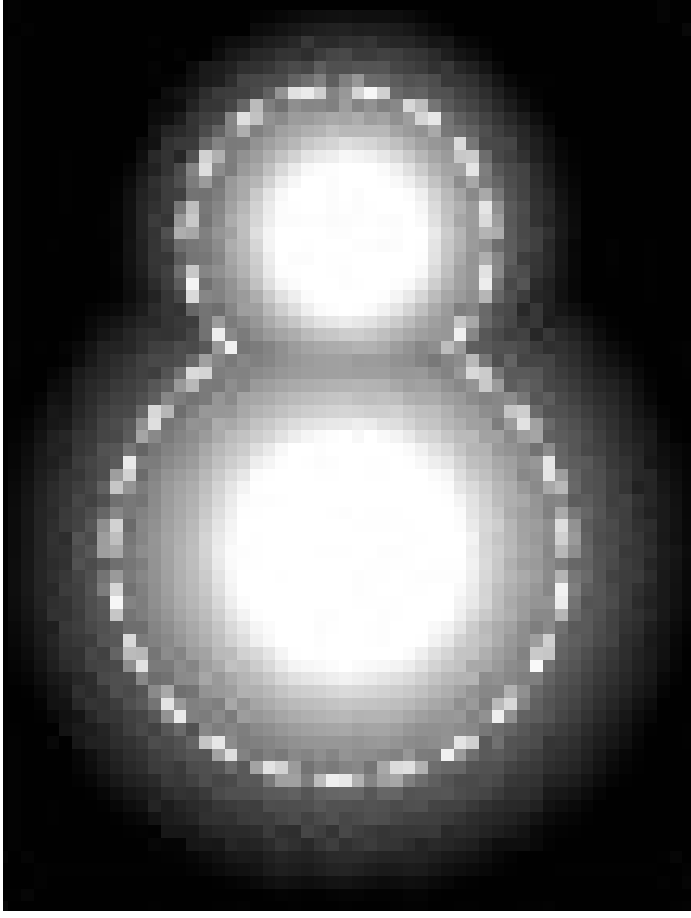
- Intersecção
 - Intersecção de superfícies algébricas de graus m e n resulta em uma curva de grau mn



Intersecção de retalhos bicúbicos possui grau igual a 324!

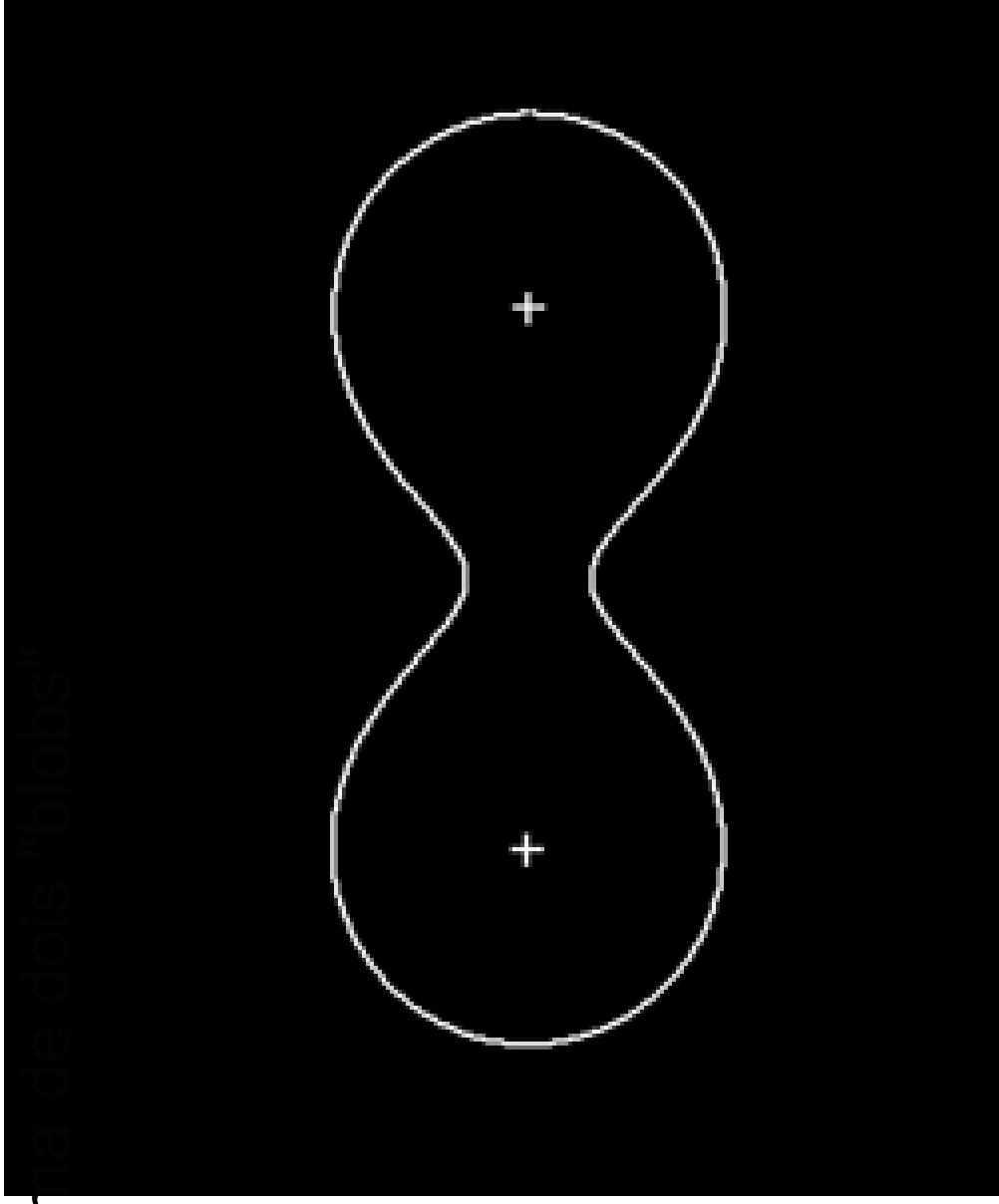
Blobby Models

- Função implícita via soma de funções base esféricas



Blobby Models

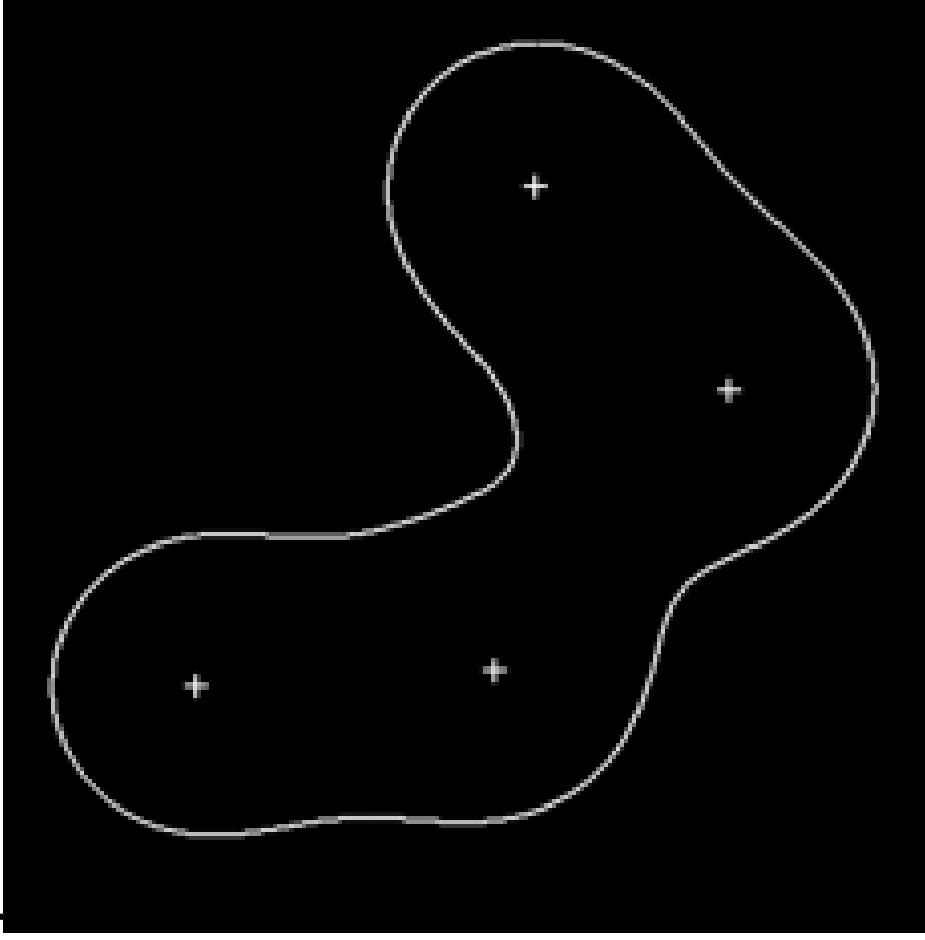
- Sorina de dois "blobs"



Turk

Blobby Models

- Soma de quatro "blobs"



Turk

Blobby Models

- "Blobby molecules"

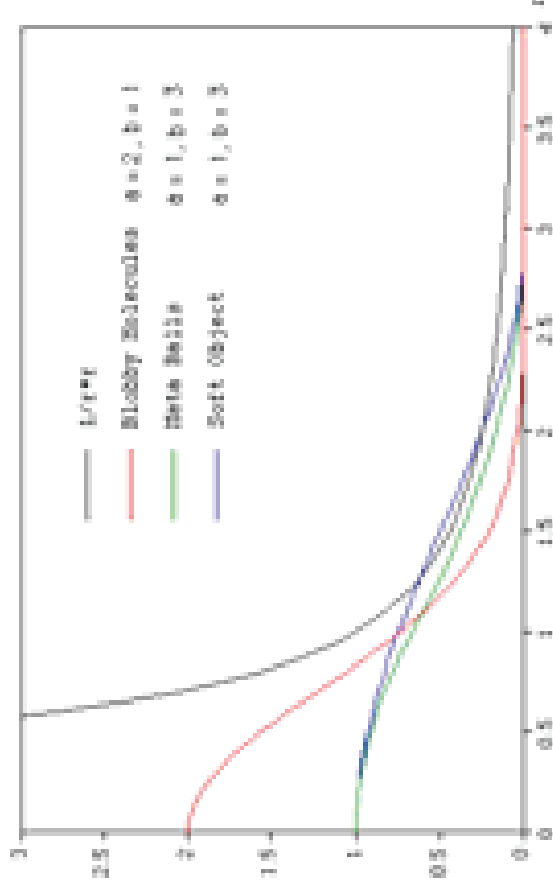
$$D(r) = ae^{-br^2}$$

- "Meta balls"

$$D(r) = \begin{cases} a(1 - \frac{3r^2}{b^2}) & 0 \leq r \leq b/3 \\ \frac{3a}{2} (1 - \frac{r}{b})^2 & b/3 \leq r \leq b \\ 0 & b \leq r \end{cases}$$

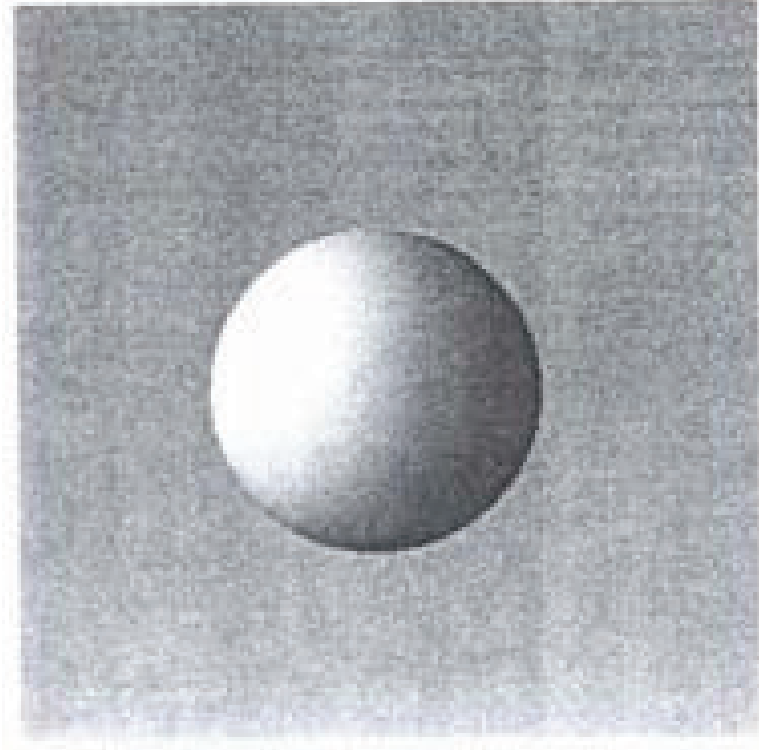
- "Soft objects"

$$D(r) = \begin{cases} a(1 - \frac{4r^6}{9b^6} + \frac{17r^4}{9b^4} - \frac{22r^2}{9b^2}) & r \leq b \\ 0 & r \geq b \end{cases}$$

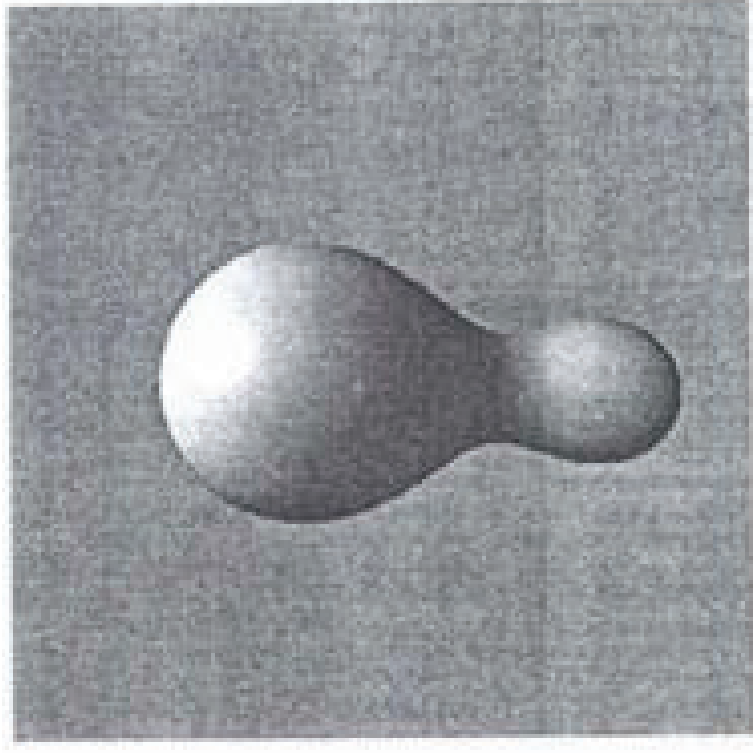


Bourke

Blobby Model de uma Face

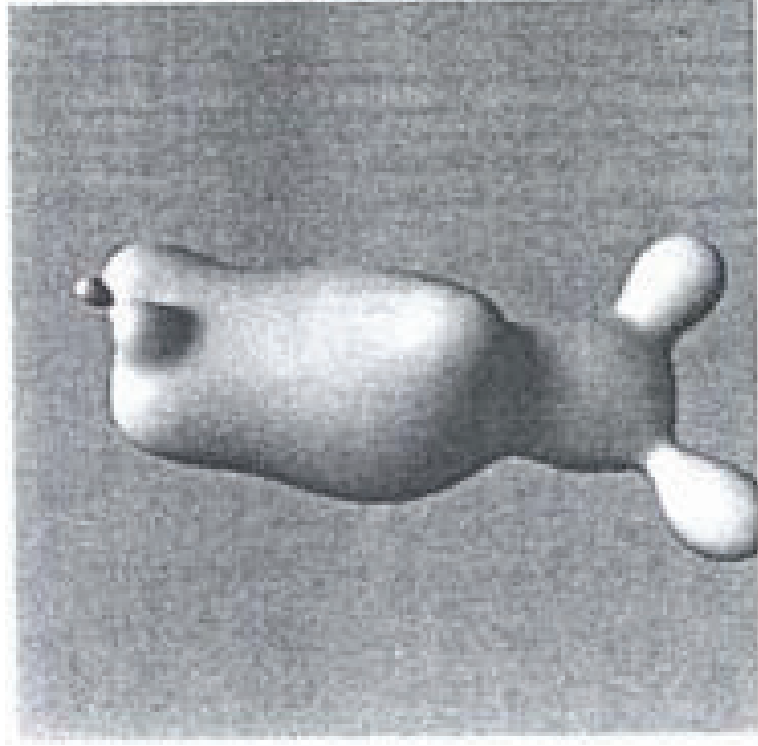


(a) $N = 1$

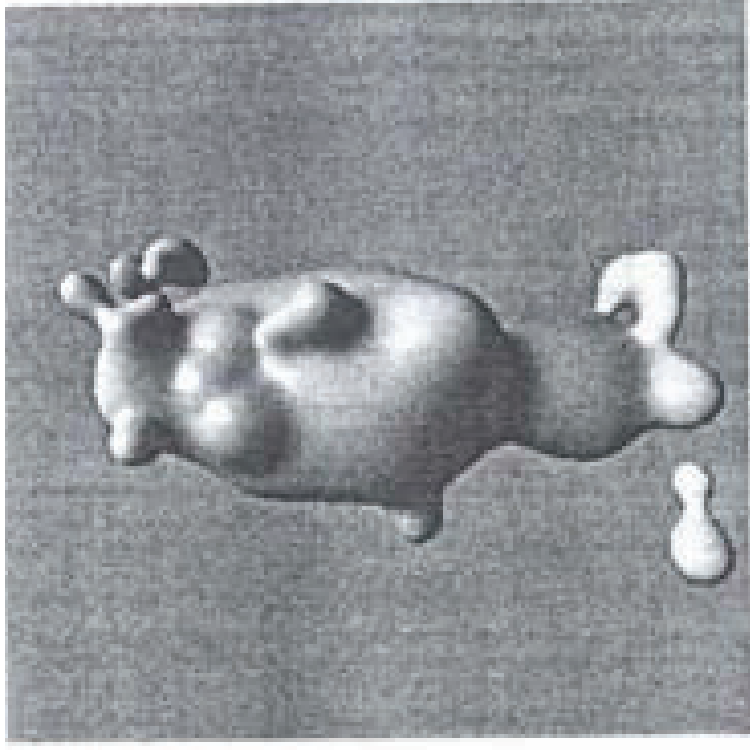


(b) $N = 2$

Blobby Model de uma Face

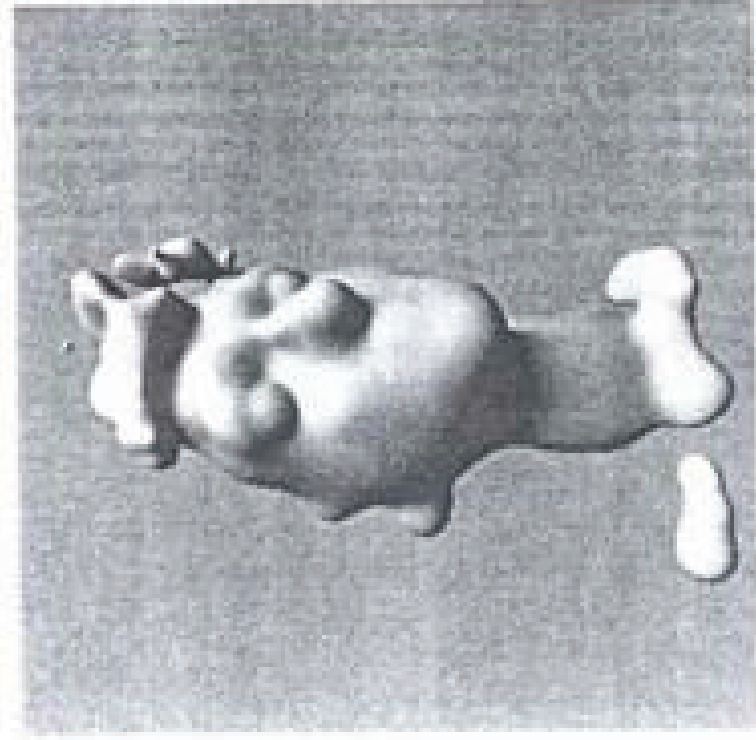


(c) $N = 10$

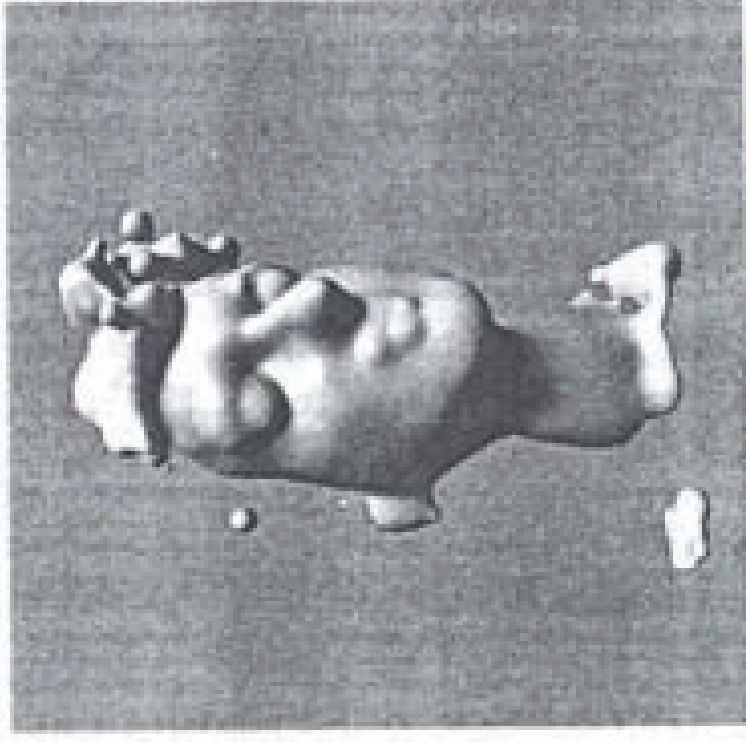


(d) $N = 35$

Blobby Model de uma Face

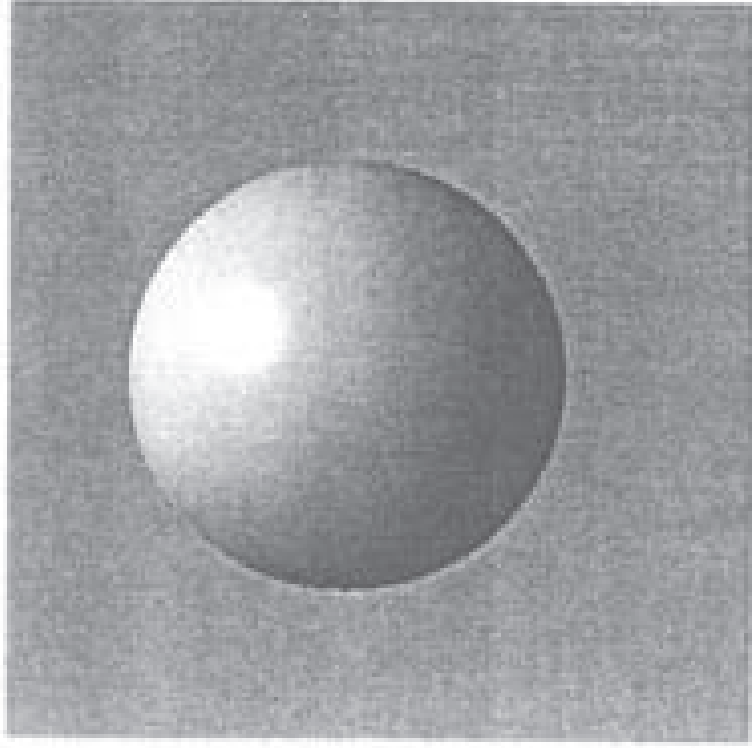


(e) $N = 70$

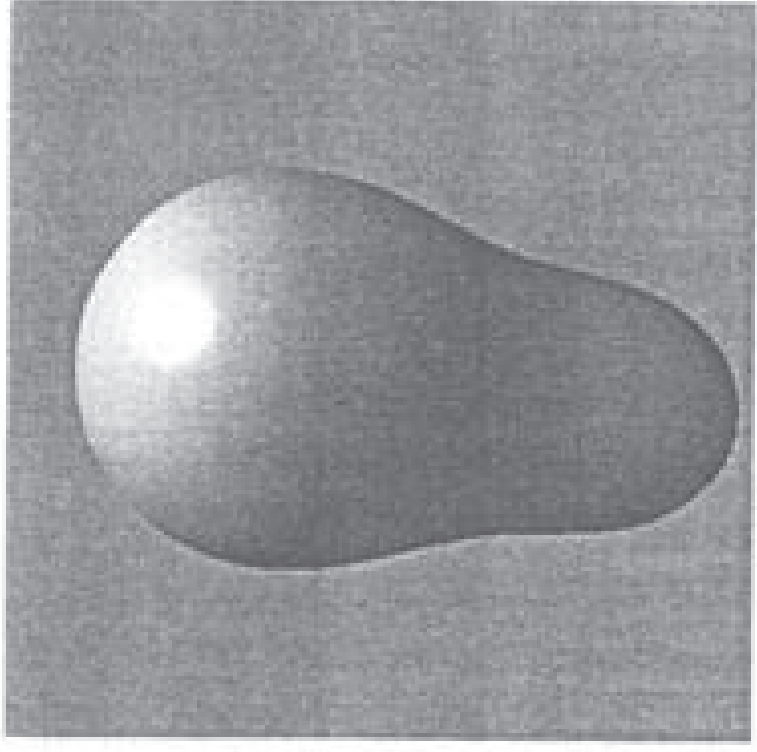


(f) $N = 243$

Blobby Model de uma Cabeça

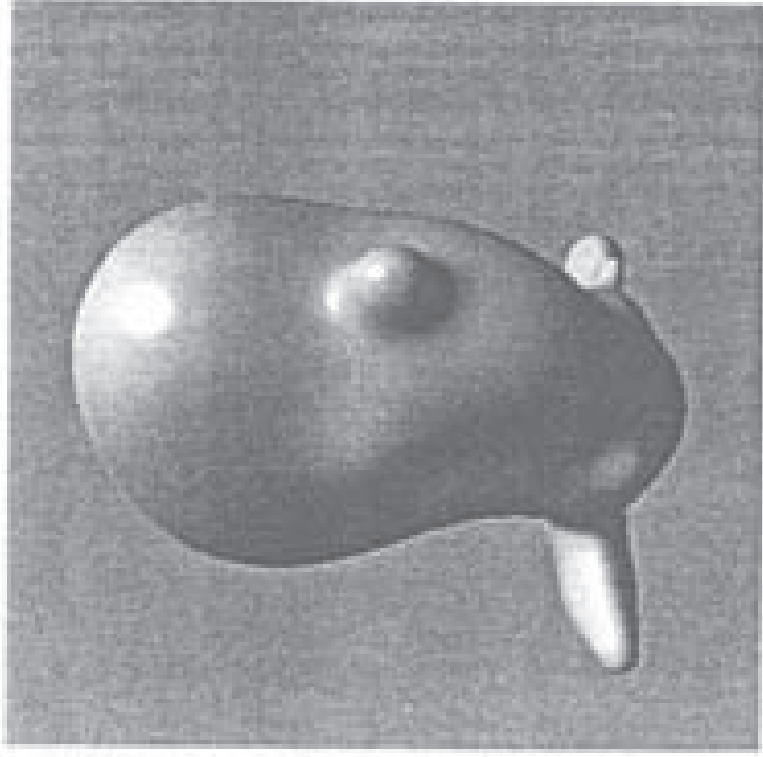


(a) $N = 1$

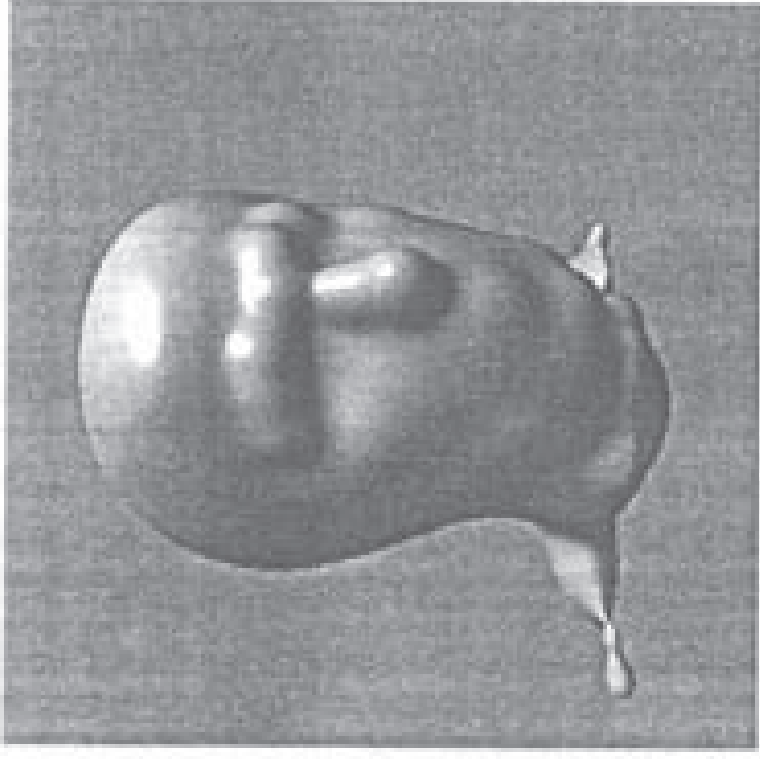


(b) $N = 2$

Blobby Model de uma Cabeça

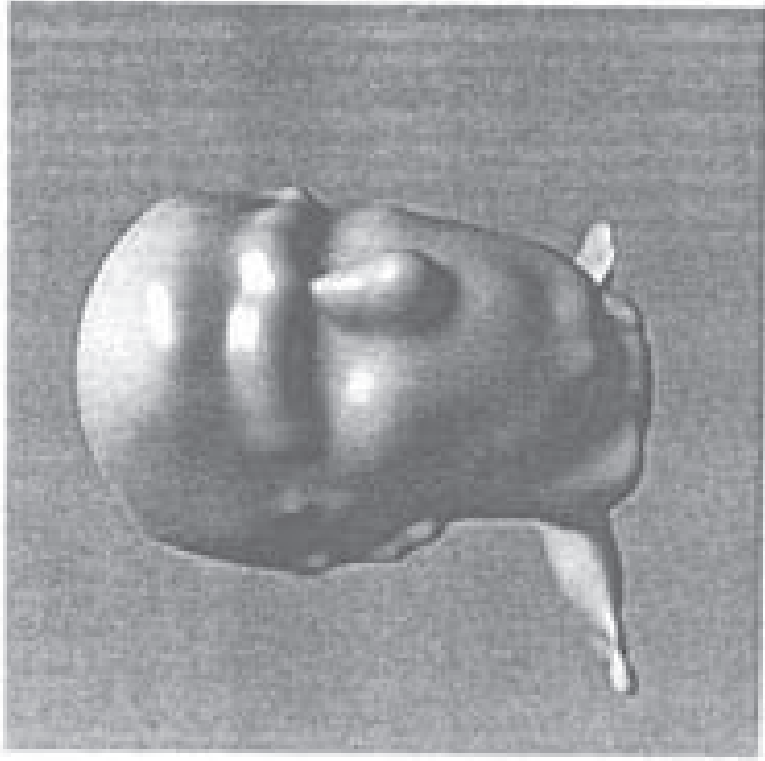


(c) $N = 20$

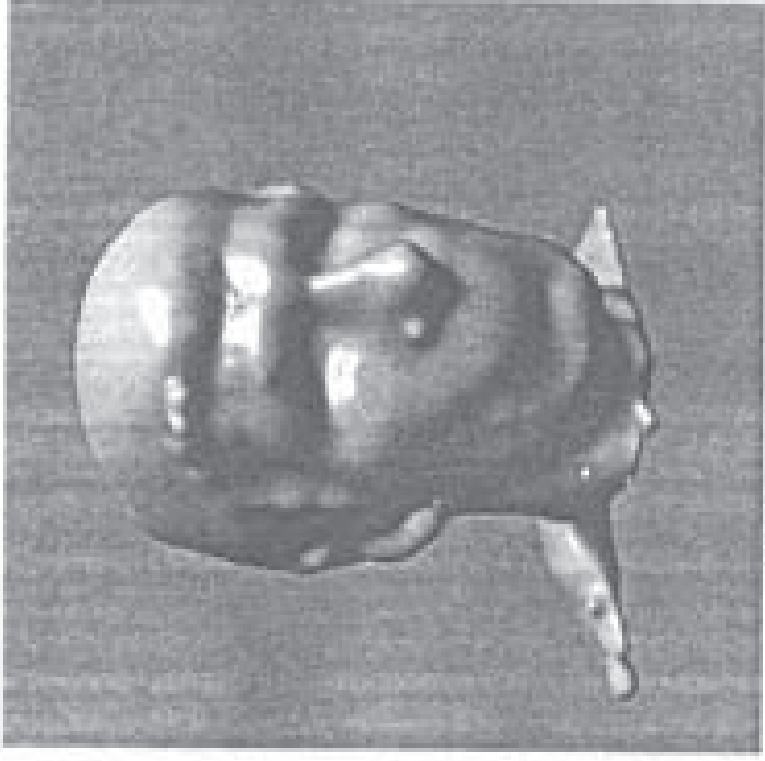


(d) $N = 60$

Blobby Model de uma Cabeça

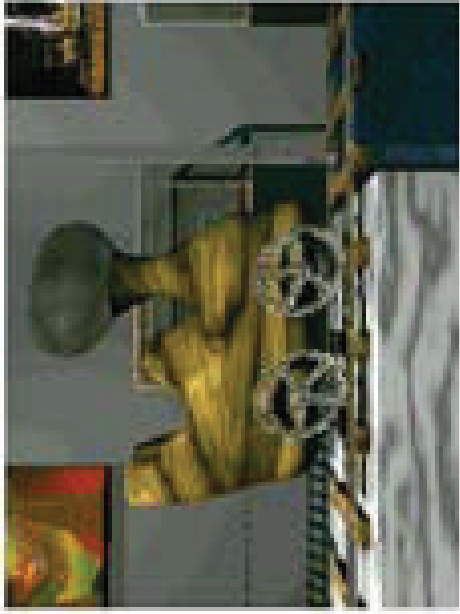


(e) $N = 120$



(f) $N = 451$

Blobby Models



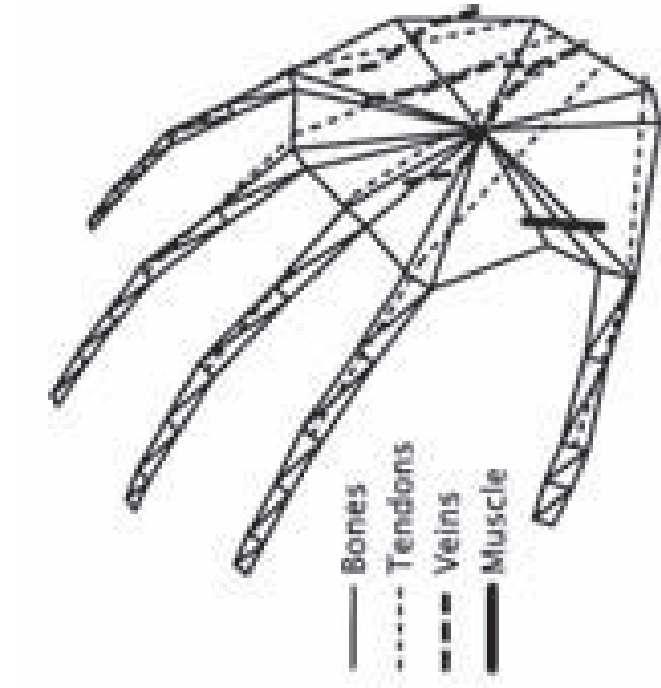
Objetos resultantes de CSG a partir
"soft objects" implícitos e outras primitivas



Menon

Esqueletos

- Superfícies de Convolução



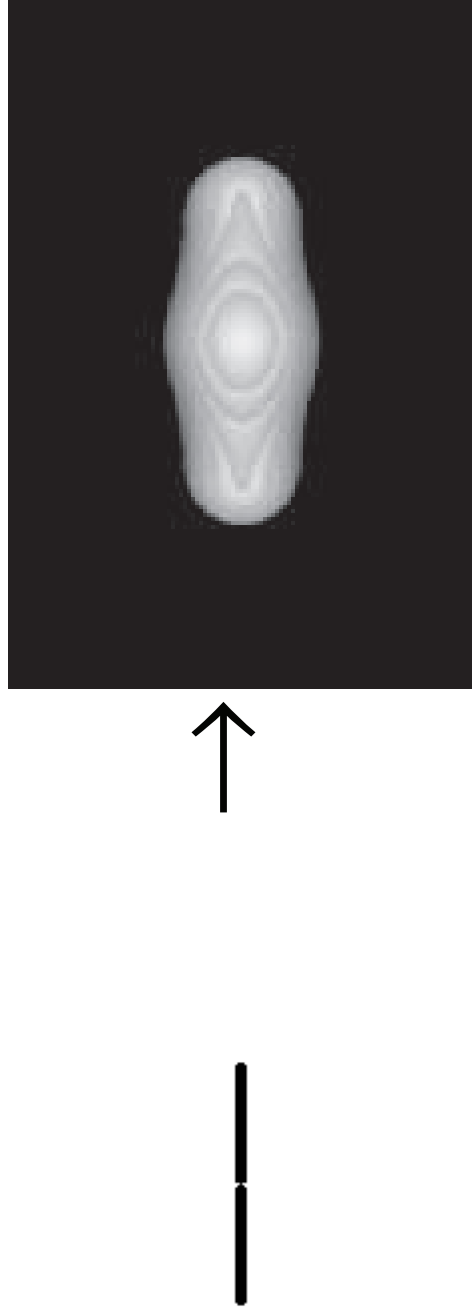
Esqueletos

- Problema da Protuberância (Bulge)



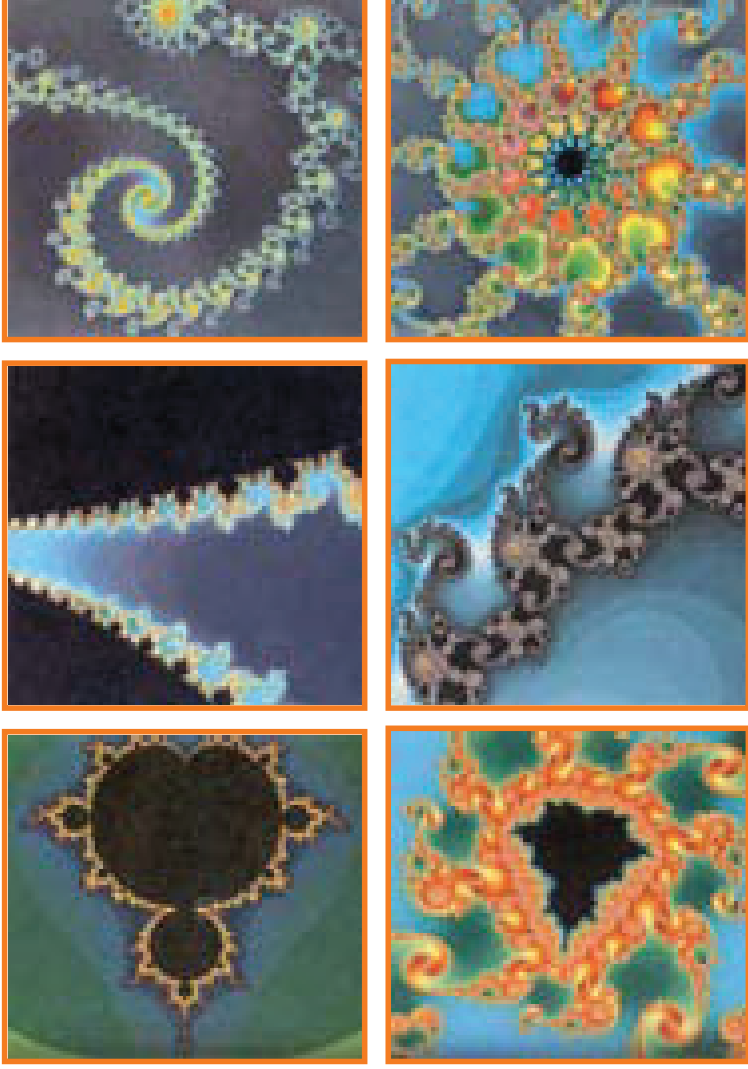
Esqueletos

- Problema da Protuberância (Bulge)



Superfícies Implícitas Procedurais

- $f(x,y,z)$ como resultado de um procedimento
 - Exemplo: Conjunto de Mandelbrot



Funções Amostradas

- Exemplo mais comum: voxels
 - Interpola-se amostras armazenadas em um "grid" regular
 - Isosuperfície em $f(x,y,z) = 0$ define a superfície implícita

