Implicit modeling

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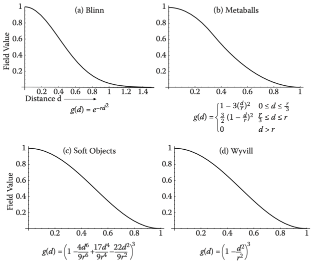
Metaballs

1. Write implicit function $f_1(x, y, z) = 0$ describing surface of a ball centered at $1, 0, 0$
2. Write implicit function $f_2(x, y, z) = 0$ describing surface of a ball centered at $-1, 0, 0$
3. What is the surface described by $f(x, y, z) = f_1(x, y, z) + f_2(x, y, z)$?
4. How can we describe two balls as implicit function? Hint: Explore properties of $F_i(x, y, z) = 1 - \frac{\alpha}{(\mathrm{r}-\mathrm{r}_i)^2}$.



Obr.: Examples of fall off functions.

1. Explore properties of $max(f_1, f_2)$ and $min(f_1, f_2)$.
   - Problems: differentiability, smoothness, lack of closed algebraic form
2. Use basic R-function $f_1 + f_2 \pm \sqrt{f_1^2 + f_2^2} = 0$ to get overlap and intersection.
3. Try Ricci blend $(f_1^n + f_2^n)^{(1/n)}$ both for small and large values of n. Compare it to max and min blends.
4. Try Pasco blend with $(f_1 + f_2 \pm \sqrt{f_1^2 + f_2^2})(f_1^2 + f_2^2)^{(n/2)}$.

1. Write implicit function that describes rectancular cuboid
2. Apply twist

$$w(x,y,z) = \left\{ \begin{array}{l} x * \cos\left(\theta(z)\right) - y * \sin(\theta(s)) \\ x * \sin(\theta(z)) + y * \cos(\theta(z)) \\ z \end{array} \right\}. \qquad (1)$$

3. Apply bending

$$s(y) = \frac{y_{\max} - y}{y_{\max} - y_{\min}} \qquad w(x,y,z) = \left\{ \begin{array}{c} s(y)x \\ y \\ s(y)z \end{array} \right\} \qquad (2)$$

4. Apply tempering

$$w(\alpha,y,z) = \left\{ \begin{array}{l} -\sin(\theta) \star (y - 1/k) + x_0 \\ \cos(\theta) \star (y - 1/k) + 1/k \\ z \end{array} \right\} \qquad (3)$$

5. Apply composition of twist followed by bend

Thank you!