Master Project - Real Time Rendering of skeletal structures - Notes on Convolution Surfaces

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1 Convolution surfaces

Convolution surfaces generalizes metaballs. Iso levelset of potential fields $f(p) = g(p) \times h(p) = \int_{R^3} g(r)h(p-r)\,\mathrm{d}r$. Where g is the geometric potential field, defined by the underlying geometry, $g = 1$ where the geometry is defined, $g = 0$ elsewhere. h is a convolution kernel, typicaly distance functions.

Example of kernels (see thesis on cinvolution surfaces)

- Cauchy function

$$h(r) = 1/(1 + s^2r^2), r > 0$$

- Gaussian function

$$h(r) = exp(-a^2r^2), r > 0$$

- Inverse function

$$h(r) = 1/r, r > 0$$

- Inverse squared function

$$h(r) = 1/r^2, r > 0$$

- Soft objects

$$h(r) = 1 - \tfrac{4}{9}r^6 + \tfrac{17}{9}r^4 - \tfrac{22}{9}r^2, r < 1, 0, r > 1$$

- Metaballs

$$h(r) = 1 - 3r^2, 0 < r < 1/3, \tfrac{3}{2}(1-r)^2, 1/3 < r < 1, 0, r > 1$$

- W-shaped quartic polynomial

$$h(r) = (1 - r^2)^2, r < 1, 0, r > 1$$

References