Weakly compressible SPH

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Introduction

Fluid simulation

Weakly compressible smoothed particle hydrodynamics

SPH formulas

Momentum

$$\frac{d\mathbf{v}_a}{dt} = -\sum_b m_b \left(\frac{P_a}{\rho_a^2} + \frac{P_b}{\rho_b^2} \right) \nabla_a W_{ab} + \mathbf{g}$$

Viscosity

$$\frac{d\mathbf{v}_a}{dt} = \begin{cases} -\sum_b m_b \Pi_{ab} \nabla_a W_{ab} & \mathbf{v}_{ab}^T \mathbf{x}_{ab} < 0 \\ 0 & \mathbf{v}_{ab}^T \mathbf{x}_{ab} \geq 0 \end{cases}$$

SPH formulas

Tension

$$\frac{d\mathbf{v}_a}{dt} = -\frac{\kappa}{m_a}\sum_b m_b W(\mathbf{x}_a - \mathbf{x}_b)\ (\mathbf{x}_a - \mathbf{x}_b)$$

Density

$$\frac{d\rho_a}{dt} = \sum_b m_b \mathbf{v}_{ab} \nabla_a W_{ab}$$

Surface reconstruction

Isotropic kernel

Anisotropic kernel (?)

Resources used

Paper:

1. Markus Becker and Matthias Teschner. 2007. Weakly Compressible SPH for Free Surface Flows. In *Proceedings of the 2007 ACM SIGGRAPH/Eurographics Symposium on Computer Animation* (San Diego, California) *(SCA '07)*. Eurographics Association, Goslar, DEU, 209–217.

2. Robert Bridson. 2016. *Fluid Simulation for Computer Graphics (2nd edition)*. CRC Press.

Resources used

Taichi

C++

Tbb

Libigl

Eigen

Demo