Simulation in Computer Graphics - Exercises

Computer Graphics - Computer Science Department - University of Freiburg

Fireworks

The goal of this exercise is to simulate and visualize fireworks.

Introduction

The idea is to start with a large particle with mass m_0 that splits into n smaller particles with masses m_i with $m_0 = \sum_i m_i$. The velocity of the initial particle is user-defined, the particle velocities after splitting are free to choose as long as the momentum is conserved, i.e. $m_0\mathbf{v}_0 = \sum_i m_i\mathbf{v}_i$.

There exist different ways to generate the velocities $\mathbf{v}_i$. Either, a random set of velocities $\mathbf{v}_i^*$ with $\sum_i \mathbf{v}_i^* = 0$ can be generated and added to $\mathbf{v}_0$ for each particle i. I.e., $\mathbf{v}_i = \mathbf{v}_i^* + \mathbf{v}_0$ which would preserve momentum as $\sum_i m_i\mathbf{v}_i = \sum_i m_i\mathbf{v}_0 + \sum_i m_i\mathbf{v}_i^* = m_0\mathbf{v}_0$.

Alternatively, a set of forces $\mathbf{F}_i$ with $\sum_i \mathbf{F}_i = 0$ (internal forces could be applied to the particle velocities $\mathbf{v}_i$ after splitting. As the sum of the applied forces is zero, the linear momentum of the system is preserved.

Implementation

- Implement a large moving particle.
- Implement the splitting into smaller particles.
- Implement the velocity change of the smaller particles with momentum conservation.
- Check the overall momentum before and after splitting.