

Simulation of paintball shot

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1 Introduction

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Low level

High level

Difficulties

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- Initial project idea:
Paintball shot on wall
- Final project:
Paintball shot on simple objects

Video

Expected challenges

- OpenGL
 - showing simple objects
- SPH solver
 - time to make it work as expected

Approach

- SPH solver
- Collision handling with axis aligned boundary boxes

Why?

- SPH solver
 - splashes and droplets
- Collision handling with axis aligned boundary boxes
 - lately attacket
 - risk of heavy time investition

Low level

- C++ 11
- Eigen
- OpenGL
 - GLSL (OpenGL Shading Language)
 - GLM (OpenGL Mathematics)

High level

- 1 Shot with gravitation
- 2 Collision detection
- 3 On impact the SPH simulation starts

Difficulties

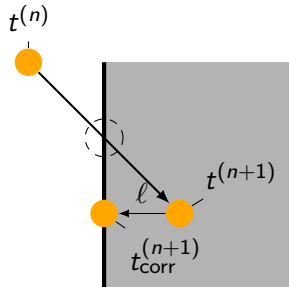
- (general code debugging)
- (parameter tuning)
- (coordinates: simulation space \leftrightarrow window space)
- many particles behaving like a ball
- particles pushed and trapped inside object
- sticky paint on object with given resolution

Tricks

- many particles behaving like a ball
 - particle-particle forces ignored before collision
- particles pushed and trapped inside object
 - projection further than on surface
- sticky paint on object
 - velocity dependent trace on object

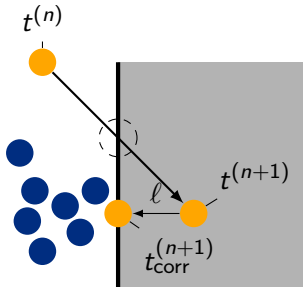
Particles pushed and trapped inside object

naive method



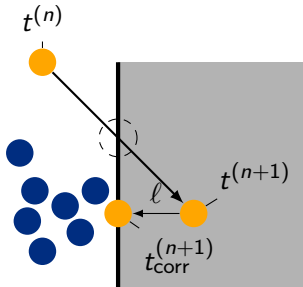
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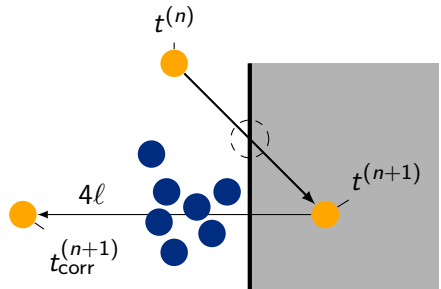


Particles pushed and trapped inside object

naive method



our method

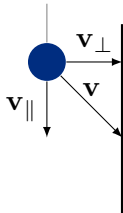


Sticky paint on object

Trace handling

Velocity split

SPH particle



Resulting trace

$$\mathbf{v}_{\parallel} = 0$$

$$|\mathbf{v}| \text{ big}$$



$$\mathbf{v}_{\parallel} \neq 0$$

$$|\mathbf{v}| \text{ big}$$



$$\mathbf{v}_{\parallel} = 0$$

$$|\mathbf{v}| \text{ small}$$



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Demonstration

Performance

- Real time simulation for simple objects (500 vertices)
- For complex objects substantially slower

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Limitations

- resolution and number of collision objects
 - bottleneck collision handling
- number of particles
 - bottleneck SPH simulation

What we learned

- OpenGL
- Blender

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- Blender

What we would do different

- Start collision handling earlier