Plano de Trabalho de Dissertação

Ano Letivo 2020/2021

Universidade do Minho
Escola de Engenharia

Nome Estudante	Paulo Alexandre Ferreira Barbosa
Título da Dissertação (em Português)	
Título da Dissertação (em Inglês)	Smoothed-particle hydrodynamics - SPH

Enquadramento e Motivação (150 - 200 palavras)

When it first was created the SPH algorithm had in mind astrophysical problems. As more and more people became aware of this algorithm, they saw other problems that could be solved by it, this includes: ballistics, volcanology, and oceanography.

Since this method was not created with the sole purpose to simulate fluids for computer graphics it is only normal that it has some limitations like the computation time it takes to run. As the years passed some researchers made some changes to the algorithm making it more stable and faster. Some of the SPH variants are:

- In 2009, B. Solenthaler developed the Predictive-corrective incompressible SPH (PCISPH)
- In 2010, M. Ihmsen introduced adaptive time-stepping for PCISPH
- In 2013, N. Akinci introduced a versatile surface tension and Adhesion for SPH fluids

Apart from all the work on the algorithm it is also needed to find some way to process all the information in a fast way. That is where fast data structures come into play. Given that this area of work could be a project by itself, the Multi-Level Memory Structures for Simulating and Rendering Smoothed Particle Hydrodynamics will be followed.

Objetivos e Resultados Esperados (150 - 200 palavras)

The present work will focus on the SPH algorithm and the variations listed above. It is intended to follow some of the evolution of the algorithm, starting with the base model and implementing some of the improvements made along the years.

The main goal is to have a fast and realistic fluid simulation and if all goes well try to create a method that includes some or all the advantages of all the SPH variants discussed. It is also intended to have a good control over the simulation by changing the value of multiple variables making it possible to simulate a vast number of fluids.

Besides the algorithm It will be Implemented a fast data structure that allows the simulation to run on the gpu, making It possible to have a real time fluid simulation.

On a final note, this work will be only focused on the simulation and not de rendering of the fluid.

Year			2019			2020						
Month			10	11	12	01	02	03	04	05	06	07
Research and understanding of the fundamentals of Smoothed-particle hydrodynamics			▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Research and implementation of new variations of SPH						▓	▓	▓	▓	▓		
Creation of a new method including the advantages of multiple SPH variants								▓	▓	▓		
Writing of dissertation									▓	▓	▓	▓

Referências Bibliográficas (5 - 10 referências)
- N. Akinci, G. Akinci, and M. Teschner. Versatile surface tension and adhe-sion for sph fluids.ACM Transactions on Graphics, 32, 11 2013.
- Markus Ihmsen, Nadir Akinci, Marc Gissler, and Matthias Teschner. Bound-ary handling and adaptive time-stepping for pcisph. pages 79–88, 01 2010
- Barbara Solenthaler. Predictive-corrective incompressible sph.ACM Trans.Graph. Article, 28, 09 2009
- R. Winchenbach and A. Kolb. Multi-level memory structures for simulat-ing and rendering smoothed particle hydrodynamics.Computer GraphicsForum, 39(6):527–541, 2020.
- Kui Wu, Nghia Truong, Cem Yuksel, and Rama Hoetzlein. Fast fluid sim-ulations with sparse volumes on the gpu.Computer Graphics Forum (Pro-ceedings of EUROGRAPHICS 2018), 37(2):157–167, 2018.

O plano de trabalho deve ser preenchido *offline* e realizado o *upload* do mesmo, depois de assinado, no formulário do requerimento de pedido de admissão à dissertação, disponível em http://dissertacao.eng.uminho.pt