Motion control on soft or liquid support

MSc research project

Advisors: Nicolas Pronost and Saida Bouakaz

This project will be carried out within the SAARA research team of the LIRIS lab in Lyon (Doua Campus).

Presentation of the project:

This project concerns the accurate and real-time simulation of real human movement. To perform such simulation, we need a model of the real human in the virtual world of the simulation. Different models can be used depending on the intended application. In this project, we focus on models capable of dealing with complex interactions with the environment. These interactions affect the simulation and we are seeking to control the motion of the virtual human regarding these interactions.

The purpose of this project is to create a new physics based motion controller for virtual characters. The current controllers are not designed to deal with complex interactions with soft bodies or liquids that can have an influence on the movement [Geijtenbeek2012]. Yet these interactions happen in many real life situations. For example, we can imagine a virtual human easily moving through 5 cm of water on a beach. This exact same human will not walk around with the same gait pattern at all with water up to the knee. It means that the controller must know how to adapt to such different situations. To do so, we need to define a mathematical formulation to describe how we expect to see humans move in these situations (e.g. by optimizing a cost function that describes the effectiveness of the gait).

Expectations for this project are twofold. (1) The student will implement a computational method for interaction between rigid bodies (representing the virtual character) and soft bodies / liquids (water, mud, snow, sand etc.) that is efficient enough to be applied to real-time animation. (2) The student will use this method (i.e. mainly collision handling) and a physics based controller to produce plausible locomotion (walking and running).

Keywords:

Physics based animation – real-time motion control - interaction rigid / soft bodies

Applications:

A first application field for this project is the animation for the film industry since these developed models and simulations are generally too heavy for real-time animation of multiple characters (rendering liquids or soft bodies is very time expensive). A second application field is life science. In orthopedic surgery, the design of lower-limb prosthesis is a complex issue, especially the management of the contact between the prosthesis and the ground, and its influence on the balance of the person. This project may, for instance, provide medical staff with computational tools tailored to their needs, allowing them to test hypotheses on the mechanics of a prosthesis.

Continuation of the project: This project can be pursued as a PhD thesis.

Prerequisites and technical information:

The developments will be primarily done with C++ or C# on Windows. The knowledge of an OO programming language is therefore required. The project is mainly about physics based animation, so an interest in software development for this type of environment is desirable.

Preliminary work for this project have been already done within the research team. The student will for example have access to projects studding the possibility of using a variant of the Material Point Method [Stomakhin2013] (see Figure 1) for managing interactions between rigid bodies and liquids.

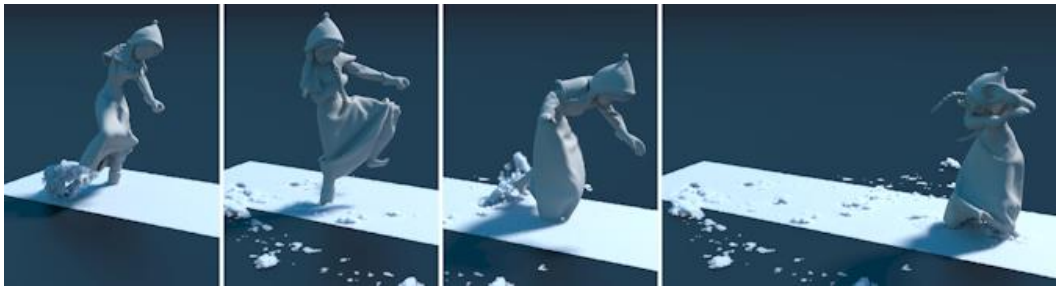

Figure 1: Interactions between a virtual character and snow in Frozen © Disney [Stomakhin2013]

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