Master 2 Internship - 2017 :
Inverse Dynamic Modeling of Cloth

Hosting lab: BiPop and Morphéo teams at Inria and Laboratoire Jean Kuntzmann (Grenoble)

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Keywords: Inverse cloth design, simulation of plates and shell under frictional contact, parameter estimation, nonlinear optimization, computer graphics, computer vision.

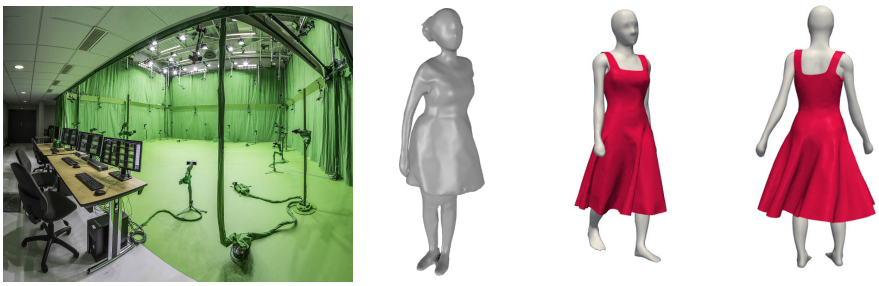

Figure 1: The problem we intend to look at is the following: how to estimate the mechanical parameters (stiffness, mass, friction coefficients, etc.) of real cloth, given, on the one hand, a geometric capture of cloth (middle) acquired from real motion thanks to a dedicated platform (left), and, on the other hand, a realistic cloth simulator (right). This inverse problem formulates as a nonlinear (and even nonsmooth) optimization problem.

Scientific Context: The Morphéo team located at Inria Grenoble has developed an expertise in 3D geometric reconstruction of human body shapes in motion from markless capture, thanks to the use and combination of multiple camera views (see http://kinovis.inrialpes.fr). The team has recently performed some advance in segmenting the body reconstruction from the cloth reconstruction [Yang et al., 2016]. In parallel, in the BiPop team of Inria Grenoble, some

realistic simulator for computing the dynamics of cloth under contacts and Coulomb friction has been developed [Daviet et al., 2015].

The goal of this internship is to start investigating how to connect real geometric data to simulation in the case of human cloth; that is, to understand how to best estimate cloth parameters from real cloth experiments (see figure 1). Applications include non-invasive parameter measurement, cloth design, robust cloth reconstruction, and cloth retargeting.

Goal of the Internship: During this internship we shall focus on developing a robust optimization solver to estimate cloth parameters from a dynamic sequence of meshes representing a moving cloth (possibly subject to contact and friction with an external obstacle). To start with, we shall make a few simplifying assumptions on the input data:

- The mesh sequence will be assumed to be free of artefacts;
- The geometric correspondence between two successive meshes will be provided.

The work will include 4 main steps:

1. Performing a thorough state-of-the-art on the topic of cloth parameter estimation;
2. Taking over the cloth simulator and getting familiar with input data;
3. Designing and implementing a robust optimizer to retrieve cloth parameters from input data;
4. Evaluating the quality of the results against state-of-the-art approaches.

Desired Skills: The internship includes both modeling and experimentation phases. Desired technical skills span mathematics (optimization, numerical analysis, geometry) and computer science (algorithmic, programmation). Programmation will be preferably performed in C/C++ and/or python.

Practical details: Paid internship (INRIA scale), possibility to pursue a PhD on the same topic.

How to apply: Send an email to Florence.Descoubes@inria.fr with a motivation letter, a curriculum vitae, and grades obtained during license 3 and master 1 (with the list of attended classes).

References

[Daviet et al., 2015] Daviet, G., Bertails-Descoubes, F., and Casati, R. (2015). Fast Cloth Simulation with Implicit Contact and Exact Coulomb Friction. ACM SIGGRAPH / Eurographics Symposium on Computer Animation. Poster.

[Yang et al., 2016] Yang, J., Franco, J.-S., Hétroy-Wheeler, F., and Wuhrer, S. (2016). Estimation of Human Body Shape in Motion with Wide Clothing. In *ECCV 2016 - European Conference on Computer Vision*, Amsterdam, Netherlands.