Accurate contact detection for the predictive simulation of fibre assemblies

Emile Hohnadel, Octave Crespel, Thibaut Métivet and Florence Bertails-Descoubes

Univ. Grenoble Alpes, Inria, CNRS, Grenoble INP, LJK
e-mail: emile.hohnadel@inria.fr

The goal of this work is to improve simulation tools from the computer graphics community for the exploration of the mechanics of fibre assemblies. We focus on the curvature-based numerical model for Kirchhoff elastic rods, the so-called super-helix model [1] coupled with the non-smooth frictional contact solver so-bogus [2] to conduct the simulations. These numerical models have been validated geometrically [3] but lack validation in force. We have conducted a study on the three-point bending experiment, where we observe spurious jumps in the contact forces. We explain these jumps by the low-order (segment-based) detection method used in the simulations. We propose high-order contact detection methods in two and three dimensions that completely remove these issues [4]. We further illustrate the large-scale effect of a low-order contact detection method with a force study in hair combing, as illustrated in fig. 1.

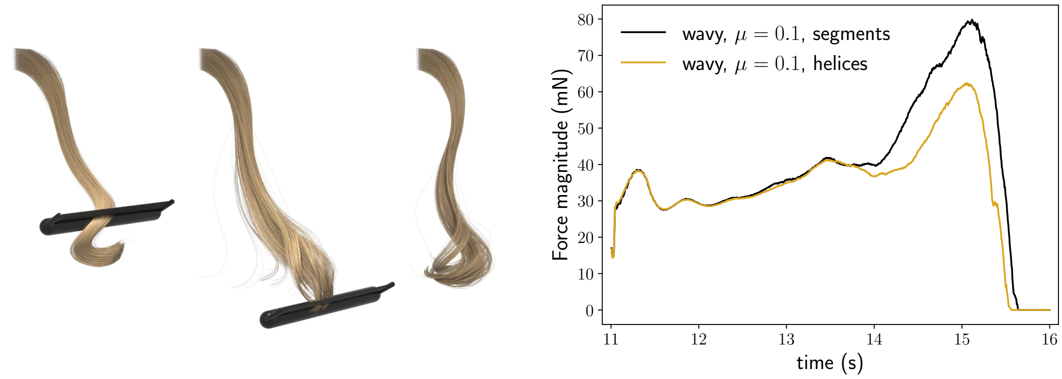

Figure 1: (left) Renders of a wisp of wavy hair during combing. (right) Comparison of the forces measured from the wisp on the comb between two contact detection methods, segment-based (in black) and exact (in yellow).

We present other protocols used to validate and calibrate the simulations against theoretical and experimental results. This lead to the study of the dissipative properties of a random architectured material [5]. Finally, we present a new two dimension implementation of the previous code more general and able to model more complex scenarios.

References

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