QUADCOVER FOR LARGE DEFORMATION SIMULATION

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ABSTRACT

To simulate the behavior of hyperelastic materials such as rubber, quadrilateral meshes are often required by the solvers. These meshes undergo very large deformations and it is a time consuming challenge for the engineers to generate meshes that are valid from beginning to the end of the simulation. Moreover, the shape of the 2D mechanical pieces which behavior should be simulated are typically quite complex.

We propose to adapt a frame-field based quadrilateral mesh generation method to account for the mesh deformations. Our method automatically produces quadrilateral meshes that are valid throughout the large deformations the mechanical piece is submitted to. From an input CAD description of the 2D shape, we use a frame-field based quadrilateral mesh generation workflow, that consists in (i) triangulating the 2D shape (ii) computing frame fields aligned on the boundaries (iii) executing the quadcover algorithm [1]. Then the simulation deforming this initial mesh is launched up to numerical failure due to the inversion of one of its elements. To go further the mesh should be modified. We propose to take into account the end state of the simulation to compute a new deformation aware frame field, allowing us to produce a deformation aware quadrilateral mesh. Additional modifications of the meshing algorithm permit to increase its robustness as well as the control of the user on the position of singularities, mesh orientation, and mesh element size. We demonstrate our method on 2D gasket models which hyperelastic deformation is simulated with an in-house software.

Keywords: quadrilateral, adaptation, hyperelastic,

REFERENCES

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