11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

CONFORMING CONTACT MANIFOLDS FOR MULTIBODY SIMULATIONS

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Key words: *Contact mechanics, finite deformation, unstructured mesh, collision detection, conforming contact manifolds.*

Computer simulation of physical phenomena involving contact mechanics is of great interest to many fields of research and industries. New applications, such as biomedical simulations, are appealing for the modelling of soft materials and sliding contact. Several different approaches have been developed over the last four decades to formulate contact constraints for numerical simulation methods. In the finite element method, mortar meshes, Lagrange multipliers and penalty approaches are widely used to handle contact constraints. We propose to develop a new simulation framework providing conforming contact manifolds for deformable multibody dynamics, based on the Moving Meshes framework [1].

Moving Meshes is a mesh framework dealing with disjoint domains interactions and finite deformations, previously applied to immiscible fluids [2]. This framework uses an ambient mesh embedding the material domains, much like the third medium proposed in [3], but without considering material properties for the ambient mesh. This discretization of the space and local remeshing performed during the simulation are useful for both collision detection and explicit representation of the contact manifold. An example mesh is shown in Figure 1a.

We extend the Moving Meshes framework to interacting deformable objects capable of dealing with contact problems. We consider nonsmooth contact interactions such as frictional contact [4] associated with an iterative solver, such as nonlinear Gauss-Seidel, for the computation of the contact forces. Instead of allowing deformable objects to intersect we form a contact manifold at the time of collision. This collision configuration simplifies the solving of the nonsmooth contact problems because the conforming contact manifold explicitly generate contact points for solving the contact constraints. We must, consequently, dynamically generate and suppress vertices and interpolate their coordinates in the reference configuration as the current space is remeshed to form conforming contact

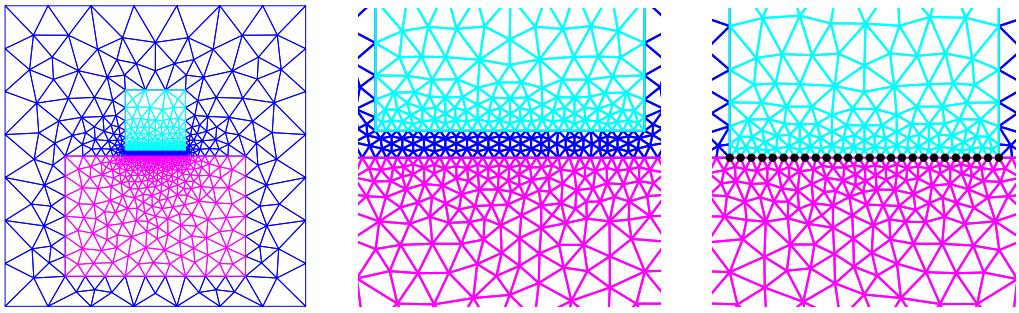

Figure 1: Mock-up mesh topology in a new approach for simulating contact between deformable bodies. Blue triangles are part of the ambient mesh and have no material properties. The rectangles are deformable bodies. Figure 1a shows the topology before contact. Figure 1b shows the details before contact. Figure 1c shows the two bodies in contact where black dots are the vertices of the conforming contact manifold.

manifolds. Numerical dissipation introduced by this strategy is studied and reference tests cases are presented for 2D simulations like that shown in Figure 1.

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