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

A NON-SYMMETRIC INTEGRAL APPROXIMATION OF LARGE SLIDING FRICTIONAL CONTACT PROBLEMS OF DEFORMABLE BODIES BASED ON RAY-TRACING

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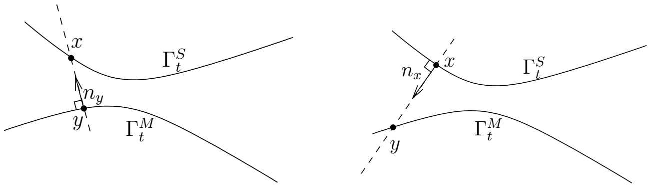
Key words: *Large Sliding Contact, Ray-tracing, Friction, Finite Elasticity.*

The aim of this presentation is to introduce a new finite element approximation of frictional contact of elastic bodies in large sliding and large deformation. The two main characteristics of this new approximation are the use of:

- An integral approximation using Lagrange mulipliers, in the sens developped in [2]. This means that contact and friction conditions are taken into account in a weak integral form using some local projections.
- A ray-tracing strategy instead of a projection one to determine contact pairs and contact normal direction.

There are several advantages of using an integral formulation. First of all, both the formulation and the tangent system are independent of the finite element method used and thus standard Lagrange elements can be used as well as more complex elements (such as isoparametric or isogeometric ones). Furthermore, there is no need to determine the set of admissible displacements and/or stresses since it is implicitely included in the formulation.

Traditionally, the contact normal direction is defined on the master surface. This convention originates from the classical node-to-segment method. Although this restriction is not present in mortar or Nitsche contact formulations, the vast majority of these methods define the contact normal according to the master surface. Some notable exceptions can however be found in [3, 1].



(a) Projection strategy (b) Ray-tracing strategy

Figure 1: *Comparison between projection and ray-tracing strategies.*

The possibility of defining the contact normal on the slave surface is strongly underrepresented in the computational contact mechanics literature. A justification for avoiding this possible option is also hard to find. The presented approximation utilizes the slave surface both for defining the contact normal and Lagrange multipliers along with a numerical integration scheme for the contact constraint terms. This choice, thanks to an appropriate mathematical treatment, results to a non-symmetric formulation whose tangent system does not depend on the curvature of the master surface and to an optimality system which is not discontinuous across mesh vertices or edges, without the need for applying any smoothing technique.

Some classical patch-tests will be presented (such as the one presented in Fig. 2) which confirm the robustness of the method.

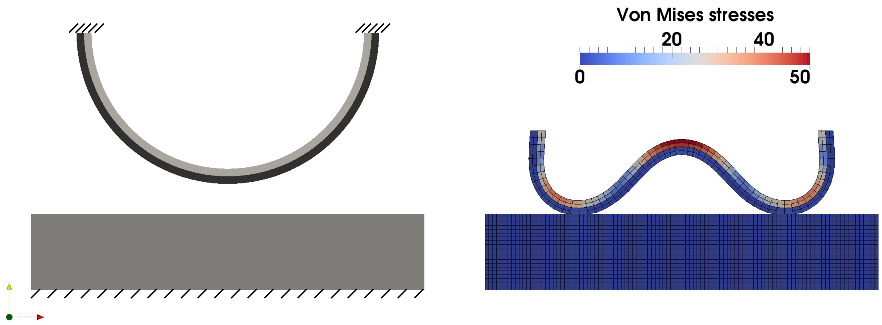


Figure 2: *Reference and deformed configuration for the elastic ring on block problem.*

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