Multiple pointwise contact search in engineering applications considering enforcement by a hybrid-barrier interface

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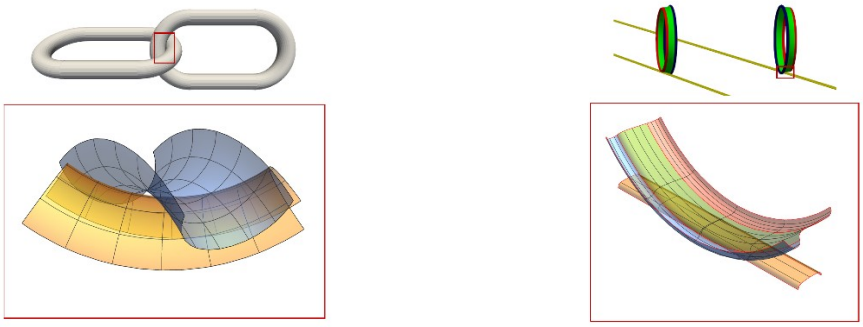
A diverse set of engineering applications involves contact mechanics. For instance, in multibody dynamics (MBD), contact may appear as a constraint or an interaction term between bodies [1]. The same applies to particle systems treated with the Discrete Element Method (DEM) [2]. In the cited research, smooth surfaces are considered, the contacts are pointwise, and the pairs of contact points satisfy the common-normal condition. However, it is known that this condition is not sufficient to elect a valid pointwise contact pair [3]. For convex bodies, such a pair is unique and is more easily distinguishable among multiple critical pairs. This is not the case when contact surfaces are nonconvex, since multiple valid solutions may exist.

Gay Neto and Wriggers [4] introduced an interface including a barrier preventing interpenetration for the enforcement of contact between polyhedra. Considering the same interface for 2D contact of curved bodies, da Silva et al. [5] showed that pairs contributing to contact must, besides satisfying the common-normal condition, minimize the distance in their neighborhood. The same can be demonstrated for the 3D case. In the present work, we present discussions on a generalization for 3D of the proposal algorithm in [5], thus seeking strategies for determining multiple pointwise contact solutions in nonconvex scenarios. For that, ideas are illustrated in two examples in which these conditions are verified (Fig. 1). The first is the contact of two chain links that occur between the parts with negative Gaussian curvature. The second is an application in railway engineering, a free wheelset entering a curved track; the wheel profile is slightly concave, making the contact surface nonconvex.



(a) (b)

Figure 1: Contact of nonconvex geometries with more than one solution: (a) chain links, (b) wheel-rail interface.

References

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