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RIGID BODY FORMULATION IN A GEOMETRICALLY-EXACT FINITE ELEMENT ENVIRONMENT WITH CONTACT INTERACTION

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Computer simulation is part of the design process of companies and research centres in the most diverse segments. Particulary, the finite element method (FEM) and the multibody dynamics (MBD) are the most popular techniques. Although such kinds of methods are now well established, they are usually developed using distinct mathematical frameworks. Nonetheless, the demand for combining rigid and flexible bodies in the same environment was the starting point for the modern research field of flexible multibody dynamics. A flexible multibody system, as defined in [1], may consist of elastic and rigid components interconnected by joints.

Regarding this context, two main research lines can be identified: (i) the inclusion of flexibility effects into the MBD formalism or, (ii) the development of efficient ways for handling large multibody systems in FEM. As already pointed out (e.g.: [2] and [3]), when the analysis of stresses, strains and wave propagation is not critical for a component, the use of rigid bodies becomes very attractive. Since the movement of a whole body can be described by a maximum of 6 degrees of freedom in a rigid approach, significant computational time can be saved.

The present work proposes a formulation to employ rigid bodies together with flexible bodies in the context of a nonlinear finite element solver, with contact interactions. Inertial contributions due to distribution of mass of a rigid body are fully developed, considering a general pole position associated with a single node. The contact formulation entitled master-surface to master-surface [4] [5] is employed in conjunction with the rigid body element and flexible bodies, aiming to consider their interaction in a multibody environment. New surface parameterizations are presented to establish the contact pairs, permitting pointwise interaction in a frictional scenario. Numerical examples are provided to show applicability of the methods.

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