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Dynamics of a flexible body: a two-field formulation. (English) Zbl 07455832
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Summary: A two-field formulation of the nonlinear dynamics of an elastic body is presented in which positions/orientations and the resulting velocity field are treated as independent. Combining a nonclassical description of elastic velocity that includes the convection velocity due to elastic deformation with floating reference axes minimizing the relative kinetic energy due to elastic deformation provides a fully uncoupled expression of kinetic energy. A transformation inspired by the classical Legendre transformation concept is introduced to develop the motion equations in canonical form. Finite element discretization is achieved using the same shape function sets for elastic displacements and velocities. Specific attention is brought to the discretization of the gyroscopic forces induced by elastic deformation. A model reduction strategy to construct superelement models suitable for flexible multibody dynamics applications is proposed, which fulfills the essential condition of orthogonality between a rigid body and elastic motions. The problem of expressing kinematic connections at superelement boundaries is briefly addressed. Two academic examples have been developed to illustrate some of the concepts presented.

MSC:
70E55 Dynamics of multibody systems

Keywords: dynamics; flexible body; multibody dynamics; model reduction; superelement

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References:
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