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Multibody dynamics simulation of geometrically exact Cosserat rods. In K. Arczewski, J. Frączek, M. Wojtyra (eds.): Proc. of Multibody Dynamics 2009 (ECCOMAS Thematic Conference). - Warsaw, Poland, 29 June – 2 July 2009.

Abstract. In this paper, we present a viscoelastic rod model that is suitable for fast and sufficiently accurate dynamic simulations. It is based on Cosserat's geometrically exact theory of rods and is able to represent extension, shearing ("stiff" dof), bending and torsion ("soft" dof). For inner dissipation, a consistent damping potential from Antman is chosen. Our discrete model is based on a finite difference discretisation on a staggered grid. The right-hand side function f and the Jacobian $\partial f/\partial(q, v, t)$ of the dynamical system $\dot{q} = v$, $\dot{v} = f(q, v, t)$ – after index reduction from three to zero – is free of higher algebraic (e.g. root) or transcendent (e.g. trigonometric or exponential) functions and is therefore cheap to evaluate. For the time integration of the system, we use well established stiff solvers like RADAU5 or DASPK. As our model yields computation times within milliseconds, it is suitable for interactive manipulation in "virtual reality" applications. In contrast to fast common VR rod models, our model reflects the structural mechanics solutions sufficiently correct, as comparison with ABAQUS finite element results shows.

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