Finite element formulations for constrained spatial nonlinear beam theories

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Abstract

We present a new director-based finite element formulation for geometrically exact beams by weak enforcement of the
orthonormality constraints of the directors. In addition to an improved numerical performance, this formulation enables the
development of two more beam theories by adding further constraints. Thus, the formulation contains the numerical treatment of three kinematically different beams which can undergo large displacements and which can have precurved reference configurations. Moreover, the hyperelastic constitutive laws allow for elastic finite strain material behavior of the beams.

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