

On nonlinear mechanics of 1-D elastic structures

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Nonlinear mechanics of 1-D elastic structures is effectively investigated in a geometrically consistent 4-D spacetime framework [1]. The 4-D trajectory manifold becomes the geometric object of interest on which motion is experienced. The Rate Virtual Power Principle is exploited and the variationally effective stress rate leveraged [2]. Distinction between material and spatial fields is clarified and material tensors are compared in a natural way by push along the motion. Constitutive relations are formulated as instantaneous incremental responses to a finite set of material tensor state variables and to their time convective rates along the motion. A computationally efficient incremental solution procedure is implemented to effectively address problems of 1-D elastic structures undergoing large displacements [3]. Elastic and non-elastic effects are considered. Numerical results for emblematic structural schemes are presented. Contributed outcomes support implementation of the presented approach for resolution of geometrically nonlinear structural problems, circumventing long-known and debated issues affecting finite deformation approaches [4].

References

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