Thermoelastoplastic modeling of one-dimensional structures

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Interest in the theory of rods has been the subject of intense research due to its applicability in several areas of scientific and applied research such as its applicability in biophysics, modeling chiral nanotubes, biomolecules, arteries, cables, ropes, strings etc. It is used in modeling deformation in slender bodies whose dimension in one direction is much longer compared to the other two. In an attempt to extract the constitutive relations for nanorods, the first part of the presentation is dedicated towards establishing a microscopic framework for one-dimensional nanostructures and thereby, deducing the expressions of their thermoelastic constants. The derived expressions were used to investigate extension, compression, torsion and bending of SWCNTs. In the second part of the presentation, we again talk about the theory of rods, but at the continuum scale. The theory of rods has been primarily used to model elastic deformations. However, we present a general framework to model their elastoplastic deformation in the theory of special Cosserat rods. A finite element formulation for the elastoplastic deformation in the special Cosserat rod theory is presented anda general elastoplastic tangent stiffness matrix is also obtained. A return map algorithm is developed in order to obtain consistent algorithmic elastoplastic tangent moduli of the rod. The formulation presented is used to study the problem of snap-through buckling of a semi-circular arch subjected to a vertically downward load at its mid-section is also investigated .

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