On Constitutive Equations for Dummies

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Summary:

Constitutive equations, which may be used for modeling dummies during impact, are presented. In addition, a unified constitutive equation, for dummies and rubber-like materials, is presented. The new constitutive equation applies to elastic, viscoelastic, incompressible as well as compressible materials. Some special cases, e.g., neo-Hookean, Mooney-Rivlin, Ogden incompressible, Ogden compressible, and many currently used constitutive equations, are given to demonstrate the versatility of the new constitutive equation. The material constants for the constitutive equation can be determined from uniaxial and biaxial tests. A constitutive equation for chronorheological materials that describes the aging and viscoelastic behaviors of elastomers is presented. A recurrence formula, that saves computing time and requires no data storage space for time-dependent physical quantities for viscoelastic constitutive equations, is also mentioned briefly.

These constitutive equations are used in numerical analyses for selecting materials to improve the performances of a dummy model used in car-crash simulations. Some results are shown. Future work is mentioned briefly.