A Cosserat model of elastic solids reinforced by curved and twisted fibers

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Abstract: A model for fiber-reinforced elastic solids, based on Cosserat elasticity theory, is discussed. The basic variables of the theory are a conventional deformation field and rotation fields that describe the local fiber orientations. Variation of a fiber-specific rotation field along a fiber trajectory describes fiber curvature and twist. This is accommodated at the constitutive level, yielding a model in which the intrinsic flexural and torsional responses of the embedded fibers are accounted for explicitly. Constraints on these fields are introduced to model the materiality of the embedded fibers with respect to the underlying continuum deformation, and the attendant Lagrange multipliers are interpreted as transverse shear tractions acting on the fiber 'cross sections'.

The model is illustrated through application to some simple boundary-value problems that yield to analytical or semi-analytical treatment.

References

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