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Size effects and internal length scales in the elasticity of random fiber networks. CATALIN PICU, Rensselaer Polytechnic Institute, KAMEL BERKACHE, EPSTA Alger, Algeria, ALI SHAHSAVARI, Rensselaer Polytechnic Institute, JEAN-FRANCOIS GANGHOFFER, Universite de Lorraine, Nancy, France — Random fiber networks are the structural element of many biological and man-made materials, including connective tissue, various consumer products and packaging materials. In all cases of practical interest the scale at which the material is used and the scale of the fiber diameter or the mean segment length of the network are separated by several orders of magnitude. This precludes solving boundary value problems defined on the scale of the application while resolving every fiber in the system, and mandates the development of continuum equivalent models. To this end, we study the intrinsic geometric and mechanical length scales of the network and the size effect associated with them. We consider both Cauchy and micropolar continuum models and calibrate them based on the discrete network behavior. We develop a method to predict the characteristic length scales of the problem and the minimum size of a representative element of the network based on network structural parameters and on fiber properties.

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