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ELECTROELASTICITY OF DIELECTRIC ELASTOMERS BASED ON THE ANALYTICAL NETWORK-AVERAGING CONCEPT

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Electro-active elastomers are smart materials that deform upon the application of an electric field. Despite being widely used (such as in wearable electronics, artificial muscle and soft robots), physics of electro-active polymers has poorly been understood. In this contribution, we develop a physically-based constitutive model capturing electroelasticity in electrostrictive elastomers on the basis of the analytical network-averaging concept [1, 2]. Accordingly, we replace all polymer chains in the rubber network by a representative chain. Microscopic boundary conditions of the representative chain can be averaged from the macroscopic deformation via a directional distribution of polymer subnetworks. This orientational distribution function is explicitly derived from the electromagnetic theory. By this means, electromechanical coupling is introduced into the constitutive model. The purely analytical model includes a few physically motivated material constants and demonstrates good agreement with experimental data of dielectric elastomers.

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