# Electroelasticity of dielectric elastomers based on molecular chain statistics

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| **Abstract** | The mechanical response of dielectric elastomers can be influenced or even controlled by an imposed electric field. It can, for example, cause mechanical stress or strain without any applied load; this phenomenon is referred to as electrostriction. There are many purely phenomenological hyperelastic models describing this electroactive response of dielectric elastomers. In this contribution, we propose an electromechanical constitutive model based on molecular chain statistics. The model considers polarization of single polymer chain segments and takes into account their directional distribution. The latter results from non-Gaussian chain statistics, taking finite extensibility of polymer chains into account. The resulting (one-dimensional) electric potential of a single polymer chain is further generalized to the (three-dimensional) network potential. To this end, we apply directional averaging on the basis of numerical integration over a unit sphere. In a special case of the eight-direction (Arruda-Boyce) model, directional averaging is obtained analytically. This results in an invariant-based electroelastic constitutive model of dielectric elastomers. The model includes a small number of physically interpretable material constants and demonstrates good agreement with experimental data, with respect to the electroactive response and electrostriction of dielectric elastomers. |
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