# A novel edge-based smoothed tetrahedron finite element method (ES-T-FEM) for 3D dielectric elastomers

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This paper presents a novel edge-based smoothed tetrahedron finite element method (ES-T-FEM) for dielectric elastomer (DE) based on the nonlinear field theory of DE. In the ES-T-FEM, tetrahedral elements that can be generated automatically for complicated domains are used. The ES-T-FEM uses smoothed strains over the smoothing domains associated with the edges of the tetrahedral elements to compute the system stiffness matrix. Compared with FEM, the ES-T-FEM is able to achieve close-to-exact stiffness. The numerical results have demonstrated that the ES-T-FEM is significantly more accurate than the FEM using tetrahedral elements for linear, geometrically and material nonlinear solid mechanics problems. The process in the implementation of the ES-T-FEM is quite straightforward, and there are no additional parameters or degrees of freedom. In addition, the computational efficiency of the ES-T-FEM is found better compared with the FEM.

**Keywords:** edge-based smoothed tetrahedron finite element method (ES-T-FEM); finite element method; Numerical method; nonlinear; dielectric elastomers