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A scaled boundary isogeometric shell formulation for nonlinear thickness deformations

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In recent years, the investigation of electro-active materials has become an interesting research field for the development of so called smart actuators. Typical examples of this materials include piezoelectric ceramics as well as dielectric elastomers which are deformed by normal stretches under the application of electric fields. In contrast to this deformation behavior, electro-active paper (EAPap) emerged as an alternative which is characterized by a bending deformation under the influence of an electric field [1]. The actuation mechanism is similar to the one of ionic polymer metal composites. An ionic diffusion is triggered by an external field leading to a heterogeneous distribution of ions which causes the bending of the actuator.
The present contribution aims at a numerical shell formulation which is capable to capture nonlinear deformations through the thickness of the structure. By this means, the scaled boundary method is used as a non-standard discretization technique for the determination of the through the thickness response by scaling the surface of the shell in thickness direction. The formulation is based on a parametrized mid-surface description of the shell by NURBS functions. Therefore, the proposed approach can be seen as a combination of isogeometric analysis [2] with the scaled boundary method [3] in the shell framework. The advantage of this methodology is given by a separated numerical treatment of the thickness direction of the shell.

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