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Strongly Coupled Finite Element Formulation of Electromechanical Systems with Integrated Mesh Morphing Using Radial Basis Functions

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Abstract : The paper introduces a method to efficiently simulate nonlinear changing electrostatic fields occurring in micro-electromechanical systems (MEMS). Large deflections of the capacitor electrodes usually introduce nonlinear electromechanical forces on the mechanical system. Traditional finite element methods require a time-consuming remeshing process to capture exact results for this physical domain interaction. In order to accelerate the simulation process and eliminate the remeshing process, a formulation of a strongly coupled electromechanical transducer element will be introduced, which uses a combination of finite-element with an advanced mesh morphing technique using radial basis functions (RBF). The RBF allows large geometrical changes of the electric field domain while retaining the high element quality of the deformed mesh. Coupling effects between mechanical and electrical domains are directly included within the element formulation. Fringing field effects are described accurately by using traditional arbitrary shape functions.

Keywords : electromechanical, electric field, transducer, simulation, modeling, finite-element, mesh morphing, radial basis function
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