

PROCEEDINGS

Symplectic Contact Analysis of Graded Soft Electroactive Materials

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ABSTRACT

Symplectic elasticity, first introduced by Wanxie Zhong [1,2] and extended by the authors recently, is highly effective for contact analysis of finite-sized inhomogeneous media [3–5]. Nevertheless, the application of symplectic analysis to materials experiencing finite deformation has yet to be investigated. To this end, a symplectic framework is established for the contact analysis of a rigid indenter applied on the surface of a compressible graded soft electroactive material of finite size. Based on the nonlinear theory of electroelasticity and incremental field theory, linearized governing equations are derived and transformed into the symplectic formalism, where the incremental state vectors are in a hybrid form. The dual-shifted Hamiltonian transformation of a quasi-Hamiltonian operator is proposed and rigorously proved, ensuring the dual-shifted orthogonal and adjoint relationship between incremental eigenvectors. A degenerated model is adopted for instance, where incremental eigen-solutions of special and general eigenvalues are constructed analytically, leading to a complete incremental solution from symplectic expansion. A novel incremental Hamiltonian mixed energy variational principle is introduced, which determines the coefficients of incremental eigen-solutions for superposition. The physical quantities in incremental field are numerically obtained and displayed, which may pave the way for subsequent researches on contact analysis of soft electroactive materials.

KEYWORDS

Symplectic framework; contact analysis; soft electroactive material; graded; incremental field theory

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