

PROCEEDINGS

Direct FE² Method For Concurrent Multilevel Modeling of Piezoelectric Structures

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ABSTRACT

In this paper, a Direct FE² method is proposed to simulate the electromechanical coupling problem of inhomogeneous materials. The theoretical foundation for the proposed method, downscaling and upscaling principles, is the same as that of the FE² method. The two-level simulation in the Direct FE² method may be addressed in an integrative framework where macroscopic and microscopic degrees of freedom (DOFs) are related by multipoint constraints (MPCs) [1]. This critical characteristic permits simple implementation in commercial FE software, eliminating the necessity for recurrent data transfer between two scales [2-4]. The capabilities of Direct FE² are validated using four numerical examples, including two benchmark examples, a piezoelectric arc honeycomb example and a piezoelectric composite structure example.

KEYWORDS

Direct FE² method; computational homogenization; piezoelectric structures; multi-point constraints (MPCs)

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