

PROCEEDINGS

Parameter Identification of Biphasic Hyperelastic Constitutive Model with Osmotic Pressure Based on VFM

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ABSTRACT

Soft biological tissues, like cartilage or arteries, are often modeled as biphasic, considering both solid matrix and interstitial fluid [1]. This biphasic behavior involves chemo-mechanical couplings that control interstitial fluid osmotic pressure [2]. Therefore, the research on the inverse problems of osmotic pressure in soft tissues is important. In this paper, the authors propose a virtual fields method (VFM) for identifying the constitutive model of solid-liquid biphasic hyperelasticity. This method constructs virtual fields based on finite elements (FE) to solve linearly independent virtual fields that can automatically satisfy constraint conditions of the solution of VFM. The method is divided into two steps: first, the constitutive parameters of the solid phase are identified using general FE-based VFM [3]; second, based on the identification information obtained in previous step, the reconstruction of the entire field of osmotic pressure without constitutive assumptions is achieved by proposing a movable nodal force FE-based VFM, which does not require iterative solving of the nonlinear finite element forward problem, and can be computed in parallel. The effectiveness of the proposed model is verified through numerical examples. Results indicate that even in the absence of knowledge about the constitutive model of osmotic pressure, the proposed movable nodal force FE-based VFM can rapidly and accurately identify results that are highly consistent with the correct analytical constitutive solution.

KEYWORDS

Biphasic hyperelasticity; parameters identification; osmotic pressure; movable nodal force FE-based VFM

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