Mechanical identification of layer-specific properties of mouse carotid arteries using 3D-DIC and a hyperelastic anisotropic constitutive model

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The role of mechanics is known to be of primary order in many arterial diseases; however, determining mechanical properties of arteries remains a challenge. This paper discusses the identifiability of the passive mechanical properties of a mouse carotid artery, taking into account the orientation of collagen fibres in the medial and adventitial layers. On the basis of 3D digital image correlation measurements of the surface strain during an inflation/extension test, an inverse identification method is set up. It involves a 3D finite element mechanical model of the mechanical test and an optimisation algorithm. A two-layer constitutive model derived from the Holzapfel model is used, with five and then seven parameters. The five-parameter model is successfully identified providing layer-specific fibre angles. The seven-parameter model is over parameterised, yet it is shown that additional data from a simple tension test make the identification of refined layer-specific data reliable.

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