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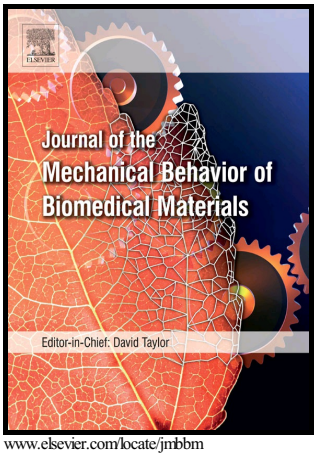

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Indentation of heterogeneous soft tissue: local constitutive parameter mapping using an inverse method and an automated rig.

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Abstract

In the domain of soft tissue biomechanics, the development of numerical simulations has raised the experimental challenge of identifying local internal mechanical constitutive data of heterogeneous organs (e.g. brain tissue). In this context, this paper presents an ex-vivo alternative characterization method to full-field imaging techniques. It is based on automated, multiple indentations of an organ section using a custom-built rig, effectively allowing to map the viscoelastic and hyperelastic constitutive parameters of the tissue at the millimetre scale, under dynamic conditions. In this paper, this technique is described and used to map the constitutive data of three sections from porcine liver, kidney and brain tissues. The results of this mapping present strong evidence of correlation between the organ constituents (e.g. white/grey matter distribution) and the identified constitutive parameters. It was also found that brain and kidney tissues are highly heterogeneous in terms of identified properties, suggesting that such a technique is essential for fully characterizing their mechanical behaviour. This method opens the way to 3D mapping of constitutive parameters to feed finite element models of the organs with region-specific properties.

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