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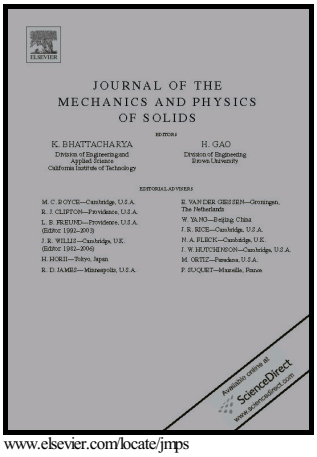

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Porous-based rheological model for tissue fluidisation

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Abstract

It has been experimentally observed that cells exhibit a fluidisation process when subjected to a transient stretch, with an eventual recovery of the mechanical properties upon removal of the applied deformation. This fluidisation process is characterised by a decrease of the stored modulus and an increase of the phase angle. We propose a rheological model which is able to reproduce this combined mechanical response. The model is described in the context of continua and adapted to a cell-centred particle system that simulates cell-cell interactions. Mechanical equilibrium is coupled with two evolution laws: (i) one for the reference configuration, and (ii) another for the porosity or polymer density. The first law depends on the actual strain of the tissue, while the second assumes different remodelling rates during porosity increase and decrease. The theory is implemented on a particle based model and tested on a stretching experiment. The numerical results agree with the experimental measurements for different stretching magnitudes.

Keywords: fluidisation, viscoelasticity, softening, cell remodelling, cell rheology

1. Introduction

Cells are complex structures consisting of a wide number of binding proteins and other solid and fluid constituents. Mechanically, they are stabilized by the cytoskeleton, a highly active contractile polymeric network which is