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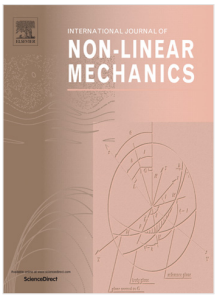

Self-influenced growth through evolving material inhomogeneities

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Self-influenced growth through evolving material inhomogeneities

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Abstract

We reformulate a model of avascular tumour growth in which the tumour tissue is studied as a biphasic medium featuring an interstitial fluid and a solid phase. The description of growth relies on two fundamental features: one of those is given by the mass transfer among the constituents of the phases, which is taken into account through source and sink terms; the other one is the multiplicative decomposition of the deformation gradient tensor of the solid phase, with the introduction of a *growth tensor*, which represents the growth-induced structural changes of the tumour. In general, such tensor is non-integrable, and it may allow to define a Levi-Civita connection with non-trivial curvature. Moreover, its evolution is related to the source and sink of mass of the solid phase through an evolution equation. Our goal is to study how growth can be influenced by the inhomogeneity of the growth tensor. To this end, we study the evolution of the latter, as predicted by two different models. In the first one, the dependence of the growth tensor on the tumour's material points is not explicitly considered in the evolution equation. In the second model, instead, the inhomogeneity of the growth tensor is resolved explicitly by introducing the curvature associated with it into the evolution equation. We perform numerical simulations to compare the results produced by these two models, and evaluate a possible role of the material inhomogeneities on growth.

Keywords: Growth, Remodelling, Material inhomogeneities, Inelastic distortions
2010 MSC: 74Bxx, 74Cxx, 74Fxx, 76Sxx, 76Zxx, 92Bxx

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