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# HOMOGENIZATION BASED TWO-SCALE MODELLING OF FLUID-SATURATED POROUS MEDIA WITH SELF-CONTACT AND FLOW IN MICROPORES

**E. Rohan[1], J. Heczko[1]**

[1] Departments of Mechanics, Faculty of Applied Sciences, European Centre of Excellence, NTIS, University of West Bohemia, Univerzitnií 8, 30100 Pilsen, Czech Republic, *rohan@kme.zcu.cz, jheczko@ntis.zcu.cz*

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The contribution is devoted to the numerical modelling of the homogenized fluid-saturated porous media subject to loads which, at the pore level, induce unilateral self-contact. The initial microstructure is periodic, being generated by a representative cell consisting of elastic skeleton and a rigid inclusion which is anchored in the skeleton on a part of its pore surface. The unilateral frictionless contact interaction is considered between the inclusion and the elastic skeleton on matching surfaces. Depending on the deformation due to applied macroscopic loads, the self-contact interaction alters the one between the solid and fluid phases. Both the disconnected and connected porosities are treated; in the latter case, quasistatic fluid flow is described by the Stokes model. Under some assumptions concerning the pore geometry, a homogenized model is derived using the periodic unfolding and the method of oscillating test functions, cf. [1]. For the closed pore microstructures, a nonlinear elastic model is obtained at the macroscopic scale. For the connected porosity, a regularization is introduced, assuming the contact interaction never close perfectly the pores, which prevents the pore connectivity. The macroscopic model attains the form of a nonlinear Biot continuum, whereby the Darcy flow model governs the fluid redistribution. We propose an efficient algorithm for two-scale computational analysis with the numerical model obtained using the FE discretization of the homogenized model. For this, a sequential linearization is used which leads to consistent stiffness matrices of the macroscopic elasticity problem [2]. At the local level, the contact problem attains the form of a nonsmooth equation which which is solved using the semi-smooth Newton method [3] without any regularization, or a problem relaxation. Numerical examples of 2D deforming structures are presented. All computations were done using the in-house developed SfePy finite element code (http://sfepy.org).

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