A B-free local *max-ent* Material Point Method for fluid-saturated porous media at large strain

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ABSTRACT

An *updated*-Lagrangian Material Point Method (MPM) model for the analysis of of large deformation problems in fluid saturated porous media is presented. Momentum and mass conservation laws are written in Lagrangian form following the pioneering work of Borja and coworkers [2]. The nonlinear constitutive model of the solid matrix which will be used here is a neo-Hookean hyperelastic material with a Kelvin solid viscous enhancement.

The resulting set of equations is discretized and subsequently solved within the framework of a local *max-ent* Material Point Method. The Local Maximum-Entropy (LME) approximants, Arroyo and Ortiz [1], are introduced as a suitable alternative for the existing interpolation techniques in most of classic MPM methods. Meanwhile, for the time integration, the Newmark-β is considered for its simplicity and robustness. The complete discretisation and implementation process of the continuum equations is done without applying the Voigt algebra rules. Therefore, in this communication, instead of using the classical B and D matrices, we will take advantage of straightforward defined tensor-based operators, see Planas *et al.* [3]. This solves the artificial gap existing between the formulation of the continuum problem and its discretized counterpart in most of the existing numerical strategies proposed heretofore for the considered set of equations. For the sake of completeness, and in order to illustrate the presented approach, a compact and elegant closed form of the resulting linearised tangent matrix is given.

Results obtained with the presented approach are in good agreement with the results described in specialised MPM texts, which show that it can be used for solving coupled large deformation accurately.

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