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A FULLY COUPLED NUMERICAL SIMULATION OF SATURATED POROUS MEDIA USING THE MATERIAL POINT METHOD

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Abstract. In this work, an improved formulation and its numerical implementation of a coupled water pore pressure and soil deformation model were presented. Among other numerical issues, it is well known the lack of objectivity of the Finite Element Method (FEM) to reproduce very large deformation rates due to extreme external actions. Therefore, in order to overcome these computational drawbacks, the theoretical approach presented in this work was implemented with an explicit numerical method known as the Material Point Method (MPM). One important aspect of this coupled formulation is the assumption of two independent sets of Lagrangian material points for each phase to accurately represent the soil skeleton and pore water pressure, for the fully saturated case. On the other hand, to avoid pore pressure oscillations, observed during the modelling of large deformation problems with spatial variation of soil porosity, an enhanced evaluation procedure of the water pore pressure gradient with a non-local Generalized Interpolation Material Point (GIMP) was proposed. The present formulation has been applied to model the progressive failure of a granular slope as well as river levees to illustrate real engineering applications. Also, the numerical results show the robustness and accuracy of the proposed method for large deformations simulations in saturated porous media.