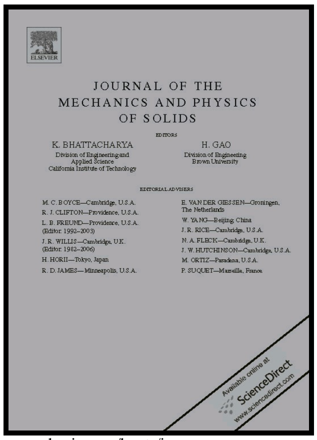

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Limit analysis and homogenization of porous materials with Mohr-Coulomb matrix. Part II: Numerical bounds and assessment of the theoretical model

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Abstract

This second part of the two-part study is devoted to the numerical Limit Analysis of a hollow sphere model with a Mohr-Coulomb matrix and its use for the assessment of theoretical results. Brief backgrounds and fundamental of the static and kinematic approaches in the context of numerical limit analysis are first recalled. We then present the hollow sphere model, together with its axisymmetric FEM discretization and its mechanical position. A conic programming adaptation of a previous iterative static approach, based on a piecewise linearization (PWL) of the plasticity criterion, was first realized. Unfortunately, the resulting code, no more than the PWL one, did not allow sufficiently refined meshes for loss of convergence of the conic optimizer. This problem was solved by using the projection algorithm of Ben Tal and Nemriovski (BTN) and the (interior point) linear programming code XA. For the kinematic approach, a first conic adaptation appeared also inefficient. Then, an original *mixed (but fully kinematic)* approach dedicated to the general Mohr-Coulomb axisymmetric problem was elaborated. The final conic mixed code appears much more robust than the classic one when using the conic code MOSEK, allowing to take into account refined numerical meshes. After a fine validation in the case of spherical cavities and isotropic loadings (for which the exact solution is known) and comparison to previous (partial) results, numerical lower and upper bounds (*a posteriori* verified) of the macroscopic strength are provided. These bounds are used to assess and validate the theoretical results of the companion (part I) paper. Effects of the friction angle as well as that of the porosity are illustrated.

Keywords: Ductile porous materials, Mohr-Coulomb matrix, Homogenization, Numerical limit analysis methods, Kinematic (upper) and static (lower) bounds

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