MatLab parallel codes for 3D slope stability benchmarks

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ABSTRACT

This contribution is focused on description of implementation details related to slope stability benchmarks in 3D. Such problems are formulated by the standard elastoplastic models containing either the Drucker-Prager or the Mohr-Coulomb yield criterion and by limit analysis of collapse states. The implicit Euler method and higher order finite elements are used for discretization. The discretized problem is solved by non-smooth Newton-like methods in combination with incremental methods of limit load analysis.

In this standard approach, we propose several innovative techniques. Firstly, we use recently developed sub-differential based constitutive solution schemes [1], [2]. Such a treatment is suitable for non-smooth yield criteria, and leads to more correct and slightly improved return-mapping algorithms. For example, a priori decision criteria for each return-type or simplified construction of consistent tangent operators are introduced. Secondly, it is used the indirect method of incremental limit analysis leading to more stable control of the loading process [2].

Within the implementation, sequential but vectorized MatLab codes were prepared at first [3]. Consequently, the related parallel codes are also developed in MatLab using Parallel Computing Toolbox. For parallel implementation of linear systems, we use the TFETI domain decomposition method [4]. It is a non-overlapping method where Lagrange multipliers are used to enforce the constraints ensuring continuity on interfaces of subdomains and on boundaries where the body is fixed. The decomposition of the body into subdomains is done by the software Metis [5]. The computation is performed by the supercomputer SALOMON in IT4Innovations National Supercomputing Center where up to five hundred of processors can be used.

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