Investigation of a soft soil excavation process using the particle finite element method
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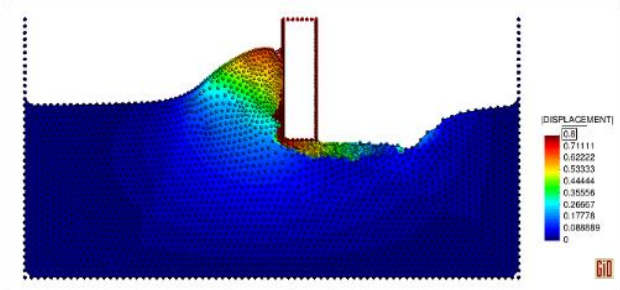
ABSTRACT

During the excavation operation of a TBM (Tunnel Boring Machine), changes occurs in the microstructure of the soil owing to the tool-ground interaction and the soil conditioning. As the TBM advances, the material is excavated and flows into the pressure chamber where the soft soil evolves from a solid to a fluid behaviour. In order to optimize the excavation and material transport processes, the relevance of this transition must be properly assessed.

In this work, we investigate the change from a solid-like to fluid-like state of the soil and its relation with the geomechanical parameters of interest. The proposed numerical implementation is based on a solid-fluid transition model [1] where the evolution of frictional internal variables such as dilatancy (β) and residual friction (μ_{res}) may be rate dependent [2]. We aim to identify zones of the excavation domain where according to a transition mechanism [1] [3], the soil could behave either as a rigid solid or as a viscous plastic fluid.

As the numerical tool, a continuum particle based method, the Particle Finite Element method (PFEM) [4] is employed owing to its ability to handle changing geometries and large deformations and displacements. The PFEM is an updated Lagrangian Finite Elements formulation that allows a proper tracking of free surfaces without excessive mesh distortion. The identification of changing boundaries is performed by means of the alpha-shape technique. A numerical model of the soil excavation operation in selected soil conditions is presented.



Numerical simulation of tool-soil interaction

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