A discrete numerical model of the front region in piping erosion

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As a major threaten for the safety of embankment dams and dykes, piping erosion is receiving increasing attention by the geomechanics community and different modeling approaches have been proposed in the last decade (Rotunno et al., 2017, Bonelli et al., 2008).

The process is driven by two main erosion mechanisms: the upstream-oriented propagation of the erosion pipe and its radial enlargement (van Beek, 2015). We have recently proposed a discrete numerical model of the soil-pipe interface at the front region (Tran et al., 2016). The model was developed with an in-house 2D code based on the Discrete Element Method (DEM) coupled with the Lattice Boltzmann Method (LBM), for the description of the granular- and fluid phase, respectively (cf Lominé et al., 2013). At a larger scale of observation, we present herein a model of the whole front region, and report on the results of an extensive parametric study. Conclusions are drawn with regards to the kinetics of the backward erosion process and on the main resistance and degradation mechanisms driving the upstream propagation of the front (arching and damage). The numerical method is also discussed, along with the technical solutions enabling an effective implementation of the hydro-mechanical coupling at the grain scale.

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