# Discrete modelling of backward front propagation in piping erosion

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## ABSTRACT

Piping erosion is often mentioned as the most dangerous ageing process affecting embankments, dams and levees as well as their foundations [1]. After the erosion is triggered at the downstream side, the pipe propagates upstream (backward front propagation) while growing in diameter (lateral expansion). On the one hand, significant efforts are to be acknowledged as to the modelling of the lateral expansion process, with analytical [2], experimental [3] and both continuum and discrete numerical approaches [4,5]. On the other hand, and despite significant analogies with the sand production problem in petroleum engineering [6,7], the front propagation process has received less attention by the geomechanical community. The way the stress state and piezometric gradients in the sensitivity region of the pipe front drive its propagation (direction and velocity) is still poorly understood: posed in these terms, the front propagation problem can be singled out as possibly the major gap to be bridged for a comprehensive modelling of piping erosion. Our work aims to investigate the complex interaction between the seepage flow and the granular skeleton in the front region, by means of discrete numerical modelling with hydro-mechanical coupling. To do so, an in-house 3D code was developed, implementing a convenient coupling between the Discrete Element Method (DEM) and the Lattice Boltzmann Method (LBM), for the granular and fluid phases respectively (cf. [5]). The general code architecture is firstly presented, along with the main technical solutions enabling an effective implementation of the hydro-mechanical coupling. We subsequently identify a relevant boundary value problem, tuned on a realistic mechanical and hydraulic characterization of the representative elementary volume across the front. Finally, the results of the numerical method, on this preliminary testing platform, are presented for a wide range of hydraulic and mechanical parameters in order to assess its reliability.

## REFERENCES

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