



# Numerical study of bedform evolution in dense granular-fluid systems under unidirectional and oscillatory forcing

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## Abstract

In this talk, we present a numerical study on the evolution of bedforms in dense sand-water systems. Our study is based on a two-phase flow model developed via a mixture-theoretic approach. According to it, both the fluid and the granular phases are modeled as coexisting and interacting continua endowed with their own velocity and stress tensor. The model incorporates a non-linear representation of the granular rheology and an evolution equation for the volume fraction of the granular phase, the latter one allowing for the capturing of evolving material interfaces (sand-pure water). In our simulations we consider two different cases, namely, open channel flows driven by unidirectional and oscillatory external forcing. While the top boundary is approximated as a flat free-slip plane. Starting from a bed with predefined undulations, we systematically explore how flow conditions and initial sand packing influence the onset and growth of shear-driven instabilities, the bed evolution and dune geometry, as well as the mobilization and migration of sand. Additionally, we present results for key features of the problem in hand, such as velocity and shear-stress profiles. The results provide new insight into pattern formation and shear-induced structuring in dense granular-fluid systems.

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