Fiber drag and conformation in 2D dense granular flow

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Abstract

From the locomotion of sandfish and plant root pull-out to the self-burying robots and soil strengthening through the incorporation of fibers, the interaction between a slender structure and a granular medium is commonly found in nature and engineering. Those problems pose multiple challenges: the non-local action of the granular medium, the slender structure's large deformations, and the couplings between the two. Therefore, this fluid-structure interaction is studied at the contact scale in 2D experiments to gain insight into the problem phenomenology. The main objective is to identify the different interaction regimes on a sinusoidal fiber fixed in space at one end, inside a quasi-static dense bidisperse granular flow. The sinusoidal fiber is an ideal representation of most shapes and permits to simplification of a complex structure to three parameters: a length, a wavelength, and an amplitude. As the fiber behaves as an elastica under a discrete heterogeneous pressure distribution, those geometric parameters vary during the tests. The experiment is designed to create either a granular domain with controlled pressure or controlled volume to get a complete picture of the different interaction regimes, with fiber shape conformation and drag force. The results of the present study will give new information on the anchoring dynamics of fibers in a granular medium.

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