Numerical and experimental tests for the study of vibration signals in dry granular flows

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ABSTRACT

Debris flows are one of the most important hazards in mountainous areas because of their paroxysmal nature, the high velocities, and energy carried by the transported material. Monitoring of these phenomena plays a relevant role in the prevention of the effects of these events. Among different possibilities, fiber optical sensors appear well-suited for this purpose thanks to their fair cheapness (with the exception of the interrogator), the robustness to electromagnetic interferences, the adaptability in extreme harsh conditions (no power supply is required), the possibility of locating the interrogator many kilometers far away from the monitored site, and the unique feature to provide very-dense multipoint distributed measurements along long distances. In this work, the vibro-acoustics signal produced by these phenomena has been focused as a possible source of information for the prediction of incipient movement, and the tracking of their path, velocity and thickness. Few literature works investigate these aspects, and for this reason, a laboratory and numerical campaign have been carried out with dry granular flume tests on an inclined chute. The discrete element method has been used to simulate the tests and to synthesize the signal measured on a instrumented mat along the channel. Different grain shapes and size obtained by a tridimensional scanning of real stones have been considered in the tests. The force-time signal has been also analyzed in time-frequency domain in order to infer the features of the flow.