Granular friction: Triggering slip motion with small vibrations

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We investigate experimentally the influence of mechanical vibrations on the characteristics of granular friction. The experimental system consists of a slider and a cantilever spring, pulled at constant velocity over a granular layer. The slider mass, spring stiffness and pulling velocity are chosen such that without mechanical perturbances, the slider exhibits a classical stick-slip motion. Horizontal vibrations are then applied to the whole system. When increasing either the amplitude or frequency of the vibrations, the amplitude of the stick-slip motion decreases, until the system exhibits a transition to a continuous slip motion. Previous numerical studies pointed out the acceleration of imposed vertical vibrations as the governing parameter for the transition, with a value of the order of the gravitational acceleration. In contrast to these results, we show that the quantity that controls the frictional properties is the characteristic velocity, and not the acceleration, of the imposed mechanical vibrations. The critical velocity at which the system undergoes the transition to a continuous slip motion is very small, of the order of 100 microns/s. Thus, when the system is statically loaded, the typical acceleration of the vibrations which trigger large slip events is much smaller than the gravitational acceleration. These results may be relevant to understand dynamic earthquake triggering by small ground perturbations.

Keywords: granular friction, stick-slip motion, vibrations, dynamic earthquake triggering

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