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TRIGS

TRIGGERING INSTABILITIES IN MATERIALS AND GEOSYSTEMS

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New and Emerging Science and Technology Pathfinder (NEST)

Deliverable n. D4.2.1
Datasets of results from experiments on size effects in granular shear (Task 4.2)

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Introduction

The granular shear apparatus developed by the CNR team has been recently modified to permit shear across a granular layer of variable height, by means of the insertion of an adjustable 'false floor'. The system has been systematically sheared with granular layers of total mass from zero to approximately 2kg, corresponding to roughly 0 to 13 granular layers. This is the first method through which the 'size' of the system will be varied for size-effects analysis. Other methods are to change the size of the particles, or [possibly] to change the area over which shear is applied.

In all experiments, the mass and inertia of the top plate are 0.75kg and 164 kg cm^2 respectively, while the range of drive velocities investigated was from 0.01 – 10 rad s^{-1}. In addition several experiments were performed in which the drive rate was varied *during* the experiment, utilising a function generator on a triangular waveform setting with 50% duty cycle and a long period (typically 300 s). In total, 56 experiments have been conducted.

Both the top plate and false floor have a layer of granular material glued to them in order to enforce granular shearing. During the experiments without interstitial granular material, then, these two surfaces shear directly over one another resulting in solid-on-solid shearing of two rough surfaces.

The data from this collection of experiments has been placed online in the collaborative dynamic webspace specifically arranged for this purpose at http://trigs.artov.isc.cnr.it/ with an introductory page at http://trigs.artov.isc.cnr.it/twiki/bin/view/TRIGS/Task42Data. The data have been divided into two sections – those with no interstitial granular medium (available at http://trigs.artov.isc.cnr.it/twiki/bin/view/TRIGS/Task42Expts070927A) and those with (available at http://trigs.artov.isc.cnr.it/twiki/bin/view/TRIGS/Task42Expts071002).

Preliminary Analyses

These results are analyses of the files located in Task42Expts070927A. Those experiments consisted of shearing a top plate across a bottom plate (each with a layer of GM glued on), with no interstitial granular medium. At present, the following graphs have been prepared (available at http://trigs.artov.isc.cnr.it/twiki/bin/view/TRIGS/Task42ResultsAnalysis):

- kx, kx-mx'', x' as functions of time for three experiments at 0.02, 0.5 and 10 rad/s. The 10 rad/s expt is almost perfectly periodic.
- Dependence of instantaneous torque on instantaneous velocity for a single experiment at 0.5 rad/s. It shows nothing of the viscous region visible in the granular experiments, but on log-log scales does show a flat region below 1 rad/s - I suppose that above this velocity, the top plate starts to saltate off the lower reducing in lower-friction. The decreasing tail could possibly be exponential.
- Distribution of the duration of slip events. This has a (short) power-law region followed by a characteristic peak for low driving velocity (< 2rad/s), after which the small events vanish,

and we are left with a narrow peak of characteristic events.

- Distribution of the size (linear extent) of slip events. Also show a power-law region (3 decades) followed by a plateau above 0.05 rad. At high driving speed (> 0.5 rad/s), the plateau is replaced by a peak detached from the power-law, but the power-law doesn't vanish until 2 rad/s.
- The torque (kx and kx-mx") distributions for each experiment. The distribution is skewed to the left for the slower experiments, unlike both previous granular expts and the expts by Johansen. Furthermore, at high driving, the distribution for (kx-mx") is very different to that of (kx) due to the very high accelerations (at 10 rad/s, the distribution of kx is resembles the distribution of a sinusoid