64th MSS-Seminar

Wednesday, November. 5th, 15:30, Nägelsbachstr. 49b

MSS

A granular flow through an orifice, solving the free fall arch paradox

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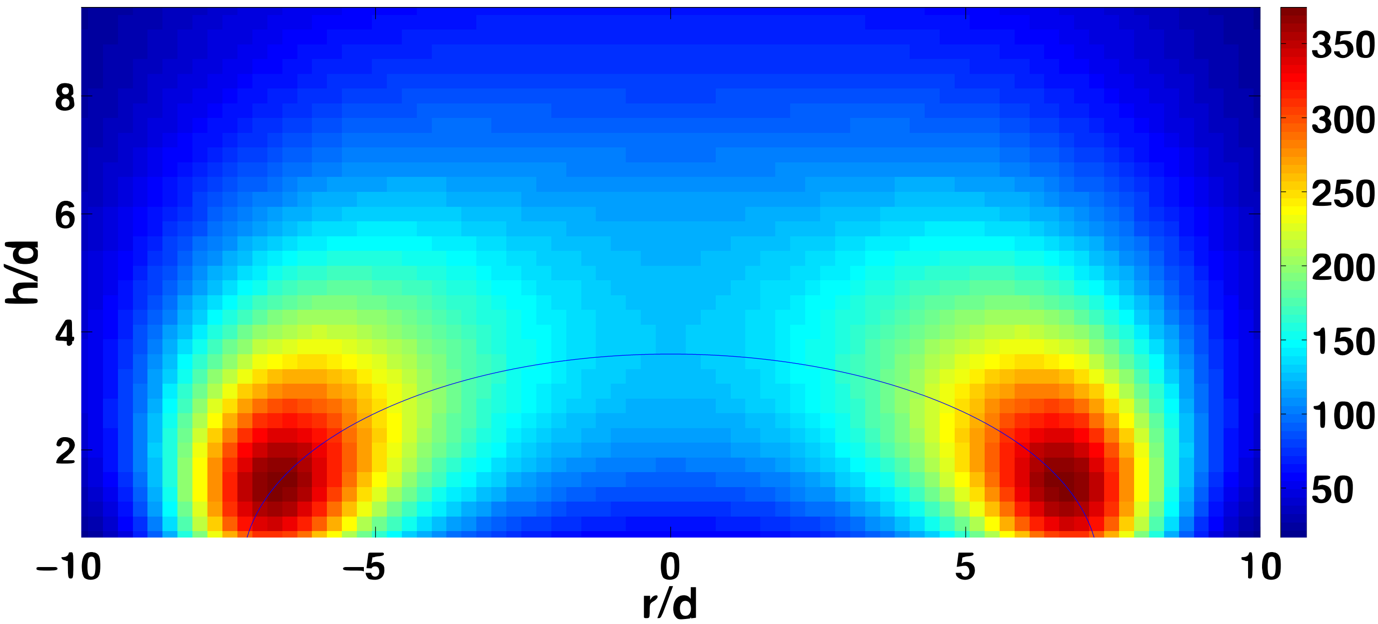

Several theoretical predictions of the mass flow rate of granular flows through outlets are based on the existence of a free fall arch region. Early in the nineteenth century, it was suggested that there is a singular region covering the silo outlet, where the particles lose their kinetic energy and start to fall freely under their own weight.

We examined experimentally and numerically the micro-mechanical details of the particle flow through an orifice placed at the bottom of a silo. Using an accurate coarse-grained scheme for the stress fields, our outcomes have notably lighted on the non trivial process that occur during the silo discharge. However, no evidence of the existence of free fall arch have been found.

On contrary, the *contact pressure* monotonously decreases when the particles approach to the exit and vanishes just at the outlet. Moreover, close to the exit this magnitude is practically independent of the size of orifice indicating that particle deformation is almost insensible to the size of the outlet.

Nevertheless, the behaviour of the *kinetic pressure* puts on evidence that the outlet size controls the propagation of the velocity fluctuations inside the silo. Examining this magnitude, we can conclusively argue that indeed there is a well defined transition region where the particle flow changes its nature. On one side (from above), the particle motion is completely correlated with the flow. When approaching to transition surface, the motion of a single particle decorrelates from the global flow, in accordance, the *kinetic pressure* reaches a maximum. Below the transition region, the contacting stress monotonously decreases and the gravity begins to play and important role, which is only dominant at the outlet where the kinetic pressure also diminishes.