

Granular flow in confined geometries: jamming, clogging, and instability

Ko Okumura *

* Department of Physics and Soft Matter center
Ochanomizu University
Bunkyo-ku, Tokyo 112-8610, Japan
e-mail: okumura@phys.ocha.ac.jp, web page: <http://www.cimne.upc.edu/>

ABSTRACT

In this talk, we will discuss three small-scale granular experiments, all prepared in two dimension: (1) drag friction in a granular medium [1-3], (2) granular statics and dynamics in a certain hopper [4], and (3) meandering airflow in a granular medium (Fig. 1) [5]. For the drag friction, we highlight the divergence of the friction force towards the jamming transition and a simple physical explanation for it. For the hopper problem, we discuss the statics of an unstable state and the dynamics of bubbles and its connection to clogging, again in simple physical frameworks. For the meandering problem, we discuss the mechanism of its destabilization and stabilization, together with a quasi-static nature. In all cases, we derive scaling laws for the phenomena on physical grounds, which agree well with experiments.

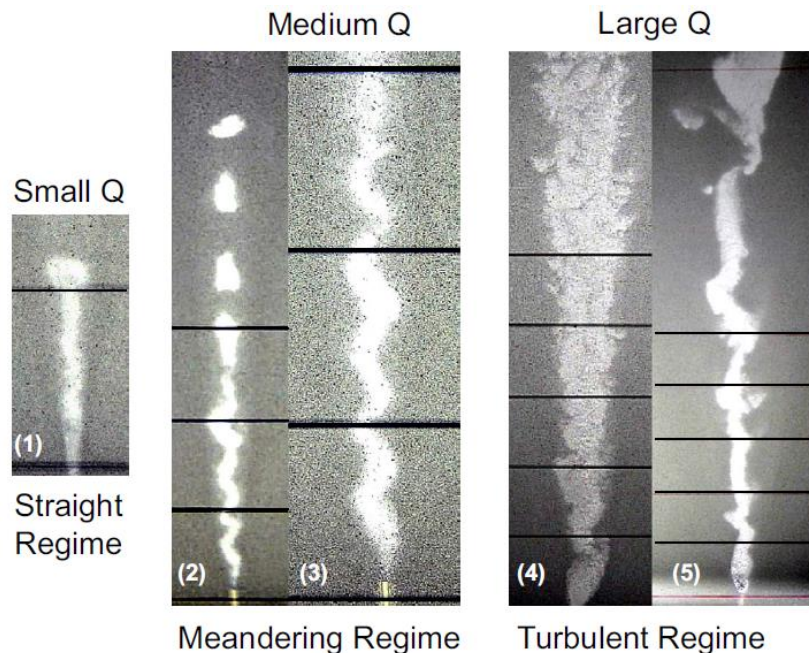


Figure 1: Instability of the path of airflow in a granular medium. The path morphology changes with the flow rate Q . Adapted from [5].

REFERENCES

- [1] Yuka TAKEHARA and Ko OKUMURA, "High-velocity drag friction in granular media near the jamming point," *Phys. Rev. Lett.* **112** (2014) 148001.
- [2] Yuka TAKEHARA, Sachika FUJIMOTO and Ko OKUMURA, "High velocity drag friction in dense granular media," *EPL (Europhys. Lett.)* **92**, 44003 (2010).
- [3] Ko Okumura, "Simple views on different problems in physics: from drag friction to tough biological materials," *Phil. Mag.* **96**, 828-841 (2016).
- [4] Yui Yagisawa, Hui Zee Then, Ko Okumura, "Stationary bubble formation and cavity collapse in wedge-shaped hoppers," *Sci. Rep.* **6**, 25065; doi: 10.1038/srep25065 (2016).
- [5] Yuki Yoshimura, Yui Yagisawa, and Ko Okumura, "Meandering instability of air flow in a granular bed: self-similarity and fluid-solid duality," *Sci. Rep.* **6**, 38457 (2016); doi:10.1038/srep38457.

