Liquid transport in granular systems under dynamic conditions

Wet granular assemblies are formed by a complex network of mechanical contacts and non-uniform liquid bridges connecting adjacent particles called capillary bridges. These bridges give rise to the so-called capillary forces (see Fig. 1). These capillary forces as well as the network of capillary bridges formed within the granular materials depend on the liquid transport and migration when particles are in contact. This phenomenon happens in many industrial processes associated with particulate systems and thus has an enormous technological and environmental importance. However, available models for liquid transport within a granular system are either unavailable or based on large number of approximations and only for specific cases.

In this project, using DEM simulations, we will examine capillary phenomena that develop in particles-liquid systems and we will develop and implement experimentally validated liquid migration model in an in-house DEM code (MercuryDPM). The prototypical apparatus is a rotating drum, where the flow, capillary bridges formation and liquid transport under dynamic condition can be characterized. Building a robust model for liquid transport under dynamic condition will enable its use for a wide range of geometries, liquids and particles, and eventually leads to reliable and enhanced numerical predictive capabilities. Additionally, this will allow answering challenging questions such as:

- How liquid migrates from one particle to another upon contact of moving particles?
- How the physicochemical properties of the liquid affect the flow in a rotating drum?
- How the shear stress affects liquid distribution within a granular system?
- How to monitor, control and optimize the humidity in the powder bulk in order to increase its flowability and mixing?

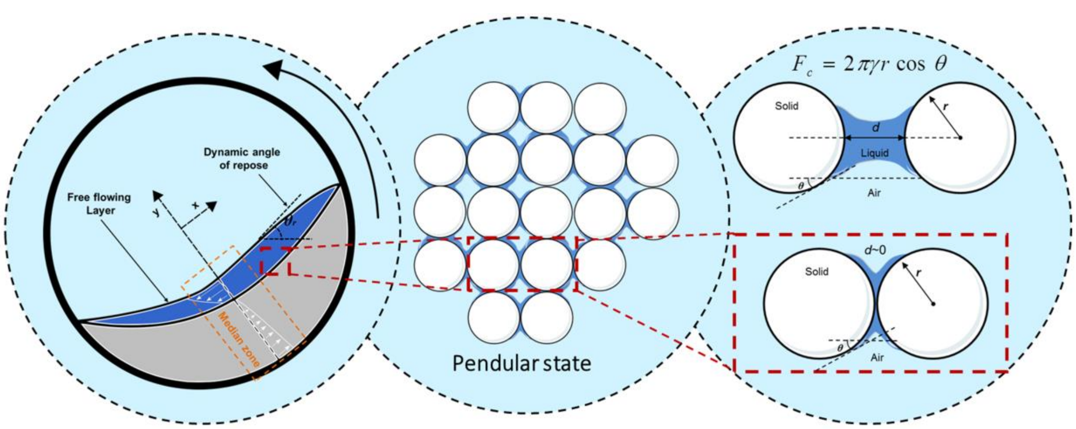

Fig. 1. Pendular liquid bridge between two identical spherical particles.

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