Effect of grain shape on the dynamics of granular materials in 2D rotating drum

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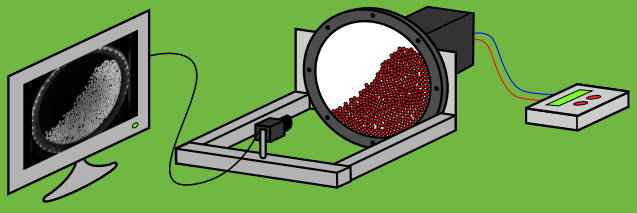
Experimental setup

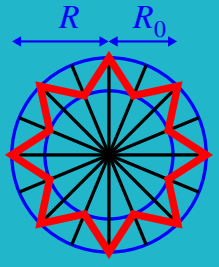
2D drum cell cut in Plexiglas with a transparent front plate and a black back plate
→ Inner diameter of 20 cm
→ Inner thickness of 3.5 mm



Grains' motion captured with a camera.
Parameters: rotation speed of the drum and grain shape.

Grain shape

Grains (cut in the same Plexiglas material) = 8-pointed stars defined by two concentric circles :

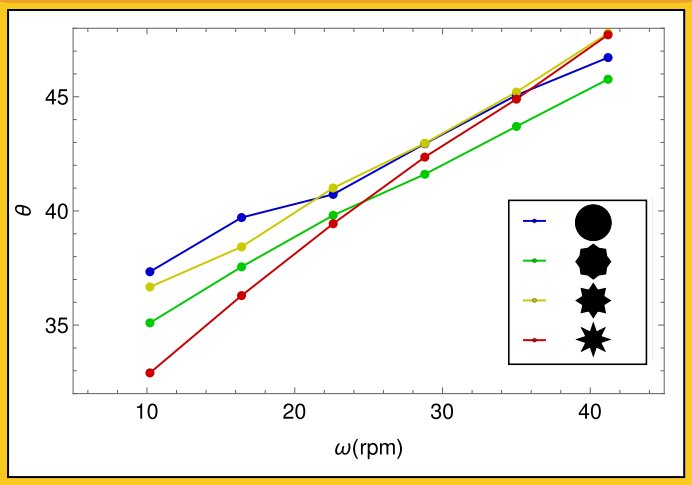


→ R/R_0 determines the grain's shape.

The circularity C quantifies the shape of the grain :

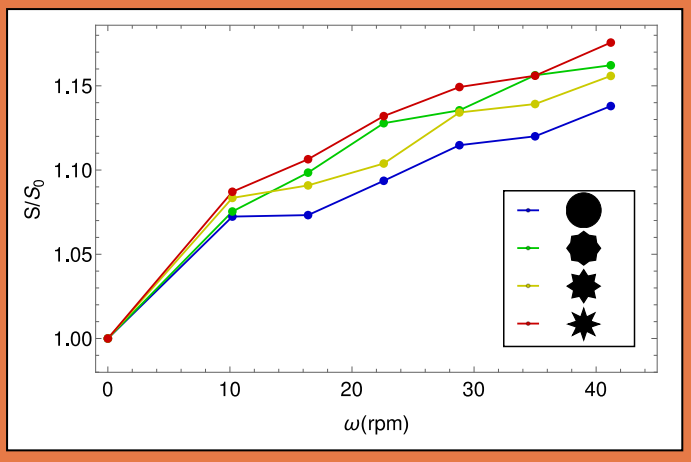
	$2R$ (mm)	R/R_0	C
●	5.3	1	1.00
✹	6	6/5	0.89
✹	6.65	3/2	0.68
✹	7.75	2	0.46

Dynamic angle of repose



Higher dynamic angle of repose for irregular grains at high rotation speeds.
→ Explained with the measurement of the dilatancy (see red frame).
Higher dynamic angle of repose for circular grains at low rotation speeds.
→ Explained with the measurement of the packing fraction (see red frame).

Dilatancy and packing fraction



High dilatancy for irregular grains at high ω.
⇒Grains get trapped in the voids of the granular bed.
At rest, the packing fraction of circular grains is larger.
⇒Higher θ due to interparticle locking.

Contact

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