High speed confined granular flows down inclines: Numerical simulations

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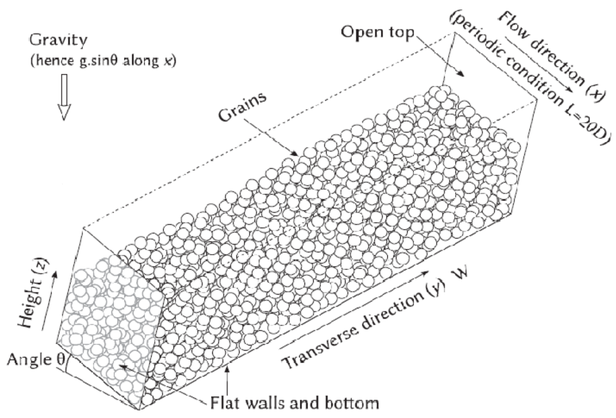
Numerical Method

Discrete Element Method[1].



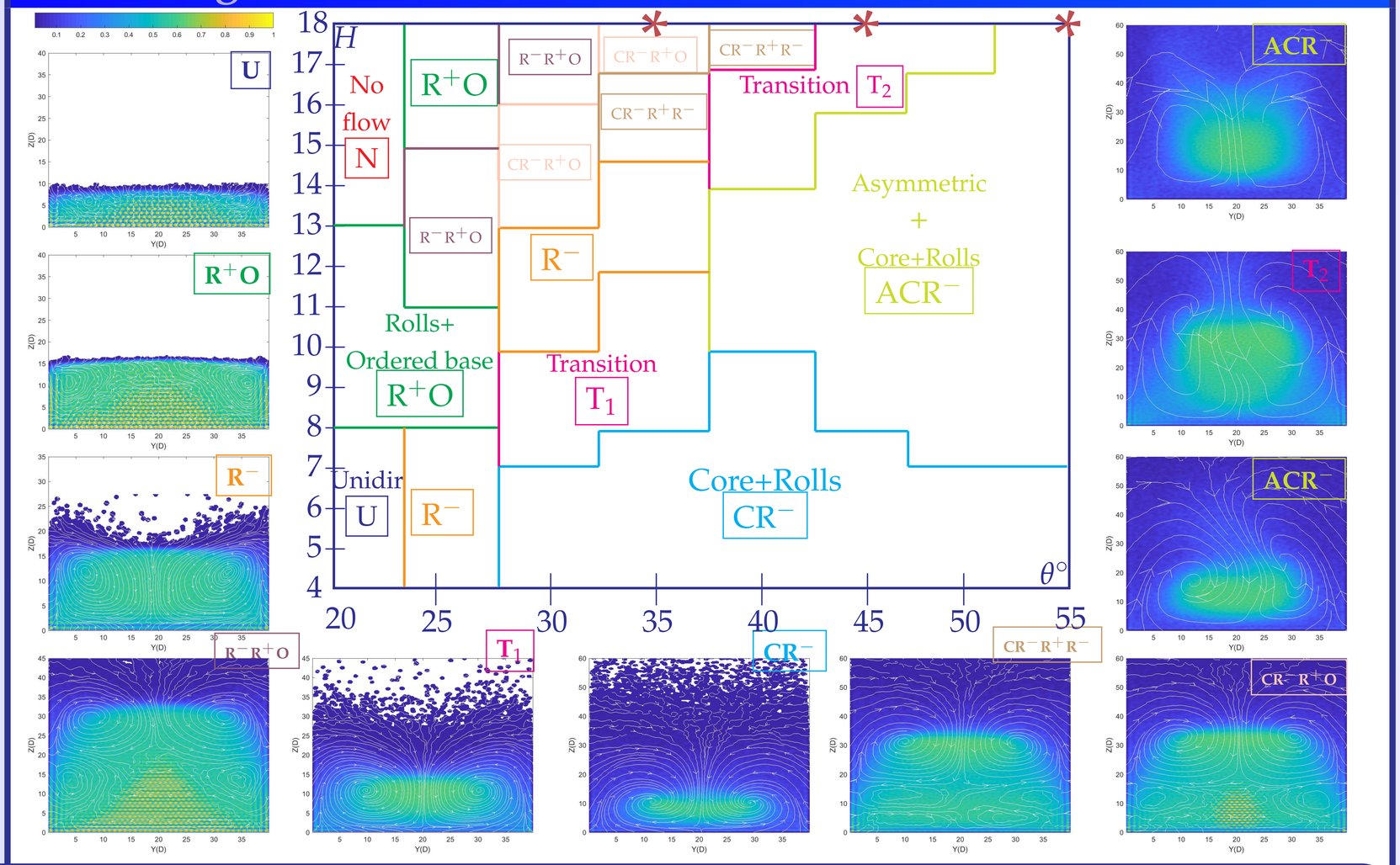
	grain/grain	grain/wall
e_n	0.972	0.8
μ	0.33	0.596

The control parameters.

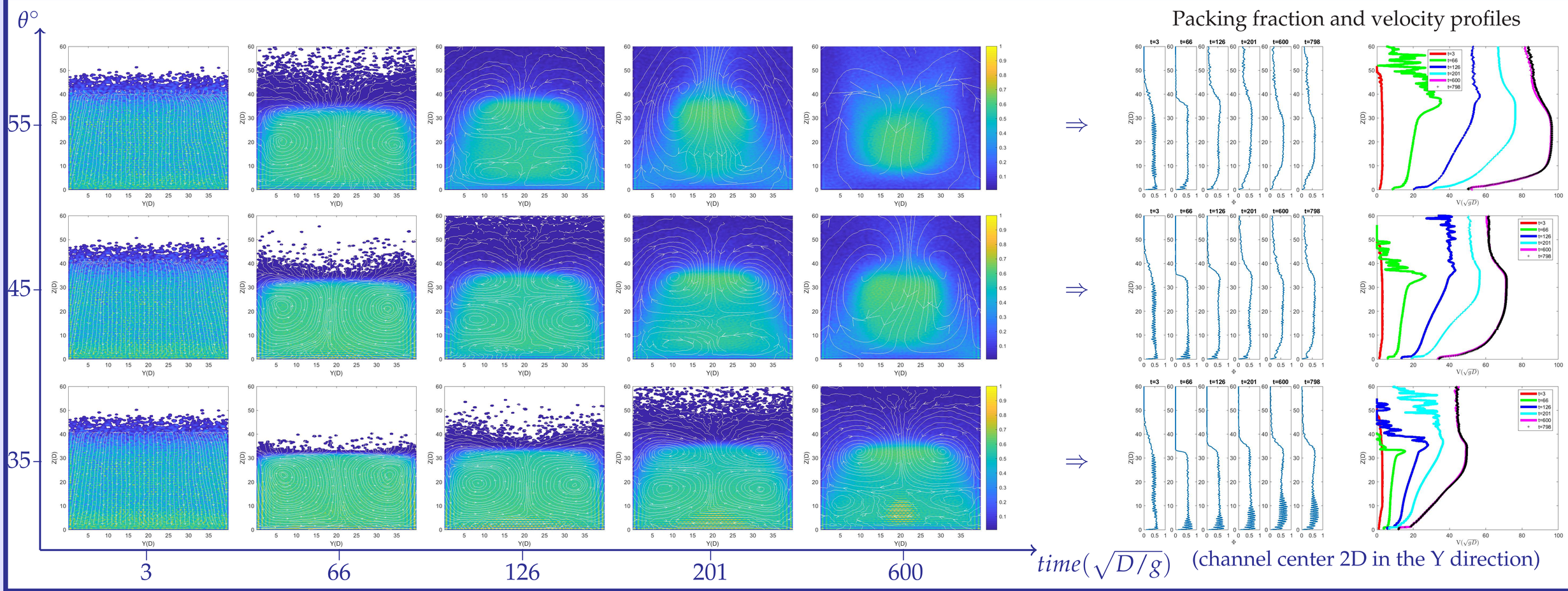
$W(D)$	$H(D)$	$\theta(^\circ)$
40	$4-18$	$20-55$

D: diameter of the grain. H: mass hold up.

Phase diagram



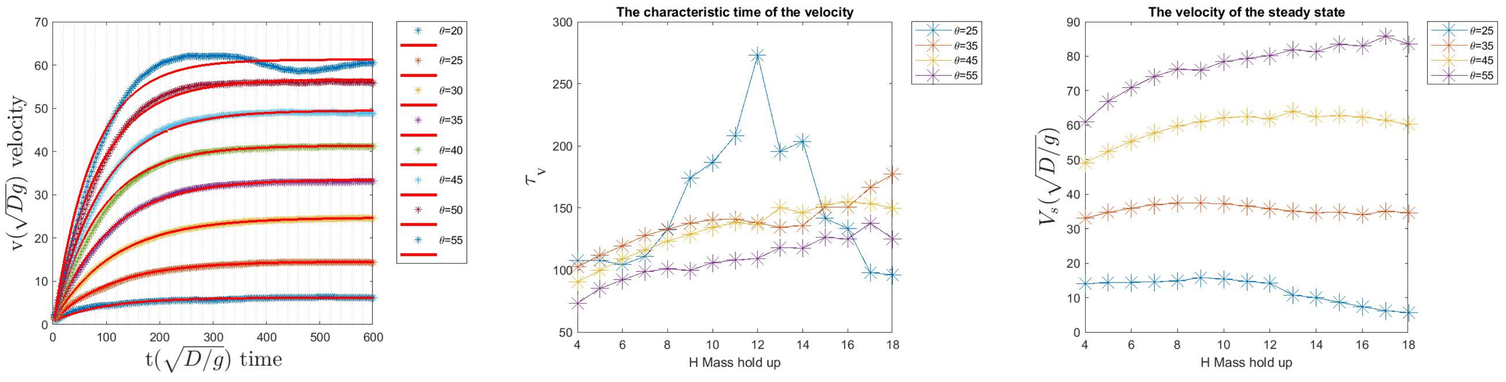
The temporal evolution of the flow H=18*



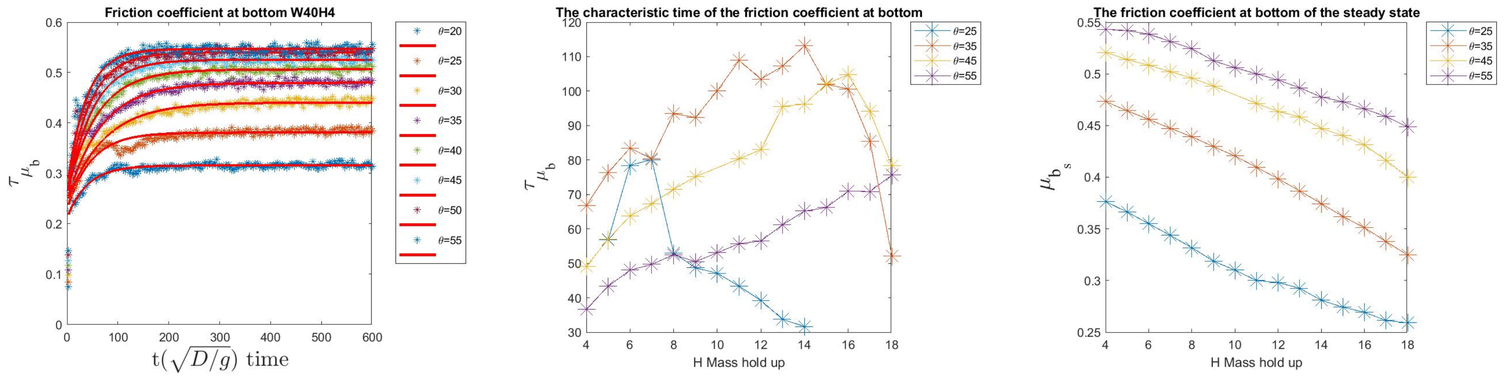
(channel center 2D in the Y direction)

Towards the steady state

1. Velocity : $v(t) = (v - v_{t_0})(1 - e^{-\frac{t-t_0}{\tau}}) + v_{t_0}$ (H=4)



2. Friction coefficient : $\mu(t) = (\mu - \mu_{t_0})(1 - e^{-\frac{t-t_0}{\tau}}) + \mu_{t_0}$(H=4)



Conclusion

1. Enriched phase diagram for $W = 40D$ in comparision with that obtained for $W = 68D$[2].
2. Most of steady states exhibit pair of rolls which can rotate with different rotation directions.
3. These rolls coexist with a dense supported core or a dynamic ordered dense base.
4. The flow reaches its stationary state through a rich transient dynamics where rolls can appear and disappear in favor of other rolls with a reverse rotation direction.

References

[1] Nicolas Brodu, Patrick Richard, and Renaud Delannay. Shallow granular flows down flat frictional channels: Steady flows and longitudinal vortices. *Phys. Rev. E*, 87:022202, Feb 2013.

[2] Nicolas Brodu, Renaud Delannay, Alexandre Valance, and Patrick Richard. New patterns in high-speed granular flows. *Journal of Fluid Mechanics*, pages 1–11, April 2015.