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Granular Transport Dynamics: Numerics and Analysis

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Abstract

We study numerically the transport of granular matter on a compartmentalized conveyor belt, being a representative model for numerous applications both in industry and the natural environment, and a prime example of an open multi-particle system prone to spontaneous pattern formation. When the inflow rate exceeds a certain critical threshold value, a cluster is formed at the entrance of the conveyor belt and the flow is obstructed. This behavior can be understood by a dynamical flux model, in which the flow from one compartment to the next is described by a flux function. We show how the detailed form of the flux function can be reconstructed from Molecular Dynamics simulations, using a least-squares method. We then investigate the relation between the form of the flux function and the precise way in which the transition from free flow to the clustered state takes place. In particular, we find that – depending on the reconstructed parameter values – this transition can either take place via a *reverse* or a *forward* period doubling bifurcation.

Key words: Clustering, flux function analysis, molecular dynamics simulations