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Spherical Shell Granular Convections

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It has been well known that a granular material in a container under vibration forms convective flow. Recent experimental studies show a succession of convective pattern, such as roll convection, cell convection, turbulent convection, as well as combinations of those for particular values of the normalized base acceleration, just like fluid convection patterns characterized by Rayleigh Number. However, what happens if a granular material packed by center core gravity in a shape of spherical shell and vibrated from the center?

This problem can never be trivial at all due to the existence of recursive information transmission around the spherical shell without side walls which control the granular flow in a container. In addition, thickness and curvature of the shell in comparison with the particle size also makes the problem quite complex. Therefore, we performed a series of numerical simulations for this problem using Discrete Element Method on GPU.

In this presentation, various types of granular convective motion developing on the spherical shell depending on the normalized acceleration and the size effect are shown. Moreover, a phase diagram to characterize those pattern formations is given.

Keywords: Granular, Vibration, Convection, Spherical Shell, Discrete Element Method