Deformable particle method - model extensions and algorithm development

Nathan Berry and Jin Sun
Glasgow University (UK)

The deformable particle method (DPM) [1, 2] is a highly versatile and efficient method to simulate systems of deformable bodies/cells. In this work, we present several developments and modifications to the DPM with the aim of simulating large systems of granular particles. Specifically, we introduce the development of a relative damping procedure for enhanced mechanical stability and additional control of particle/cell-scale behaviours. Additionally, we present an overview of a modified bending potential, utilising the signed angle between vertices, which attenuates buckling phenomena whilst providing rigidity for simulating granular particles. We will then discuss a hierarchical neighbour list scheme for contact detection, which we have developed to enable large-scale simulations of DPM systems. Finally, we present calibration results for a Hertzian particle interaction and evaluate large-scale granular systems using the modified DPM and calibrated Hertzian particles.

References

[1] A. Boromand, A. Signoriello, F. Ye, C. S. O'Hern, and M. D. Shattuck. Jamming of deformable polygons. Physical review letters, 121(24):248003, 2018.

[2] Y. Cheng, J. D. Treado, B. F. Lonial, P. Habdas, E. R. Weeks, M. D. Shattuck, and C. S. O'Hern. Hopper flows of deformable particles. Soft Matter, 18(42):8071–8086, 2022.