ISSN: 1391-8796
Proceedings of 7th Ruhuna International Science & Technology Conference
University of Ruhuna, Matara, Sri Lanka
January 22, 2020

Meshfree based computationally efficient simulation of different shaped plant cells using the cell linked list algorithm

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This work presents an application of the Cell-Linked List Algorithm (CLLA) to improve the computational performance of Smoothed Particle Hydrodynamics (SPH) based plant cell with different cell shapes. CLLA is a computationally efficient neighbourhood treatment approach, compared to the popular All Pair Searching (APS) approach conventionally used for interaction calculations of SPH. Although CLLA has been existing in the numerical modelling field, this work newly introduces it to the sub-domain of different plant cell shape modelling. Accordingly, a series of simulations were conducted on SPH based state of the art plant cell modelling using three basic shapes; hexagon, round and square cellular domains to investigate the computational time saving of CLLA over APS. CLLA with maps was set up first as simple arrays in parallel C++ source code and it resulted in 17%, 23% and 30% reduction of the computational time compared to the use of APS in the same context. Next, CLLA was setup using the vector data structure in C++ by updating the above source code and it resulted in a much different computational time saving of 30%,16% and 17% compared to the original APS. The overall outcome of this research implies that the use of CLLA can yield significant computational savings than conventional APS based approaches.

Keywords: All Pair Search (Aps), Cell-Linked List Algorithm (Clla), computational time saving, plant cell shape modelling and Smoothed particle hydrodynamics (Sph)

Acknowledgement: National Research Council (NRC) of Sri Lanka and Department of Mechanical and Manufacturing Engineering of University of Ruhuna, Sri Lanka are greatly acknowledged.

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