Domain Decomposition methods for granular dynamics using discrete elements and application to railway ballast

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Abstract:

Simulation of granular media undergoing dynamic evolution involves nonsmooth problems when grains are modelled as rigid bodies. With dense samples, this nonsmoothness occurs everywhere in the studied domain, and large sized systems lead to computationally intensive simulations.

We combine domain decomposition approaches and non smooth contact dynamics by focussing on two difficulties: the discrete geometry and the non smooth behaviour.

Two types of partitioning of a granular domain are investigated. In the case of a discrete structure, there are two common ways to partition it: (i) distribute the elements, the links, or the interactions among substructures, or (ii) distribute the nodes or the grains among substructures.

These approaches lead to different non smooth DDM solvers based on the Non Linear Gauss Seidel algorithm.

As an illustration, a portion of railway track, 7 sleepers, have been submitted to a tamping process. This numerical simulation have been performed on a sample composed of 90000 digitized ballast grains and the numerical analysis underlines the influence of tamping process from one sleeper to another sleeper in terms of compaction, and local mechanical indicators. We propose a pre-study consisting of underlining relevant qualitative parameters to appreciate the pertinency of the computation. Next the number of iterations per subdomain is correlated to the convergence of these parameters.

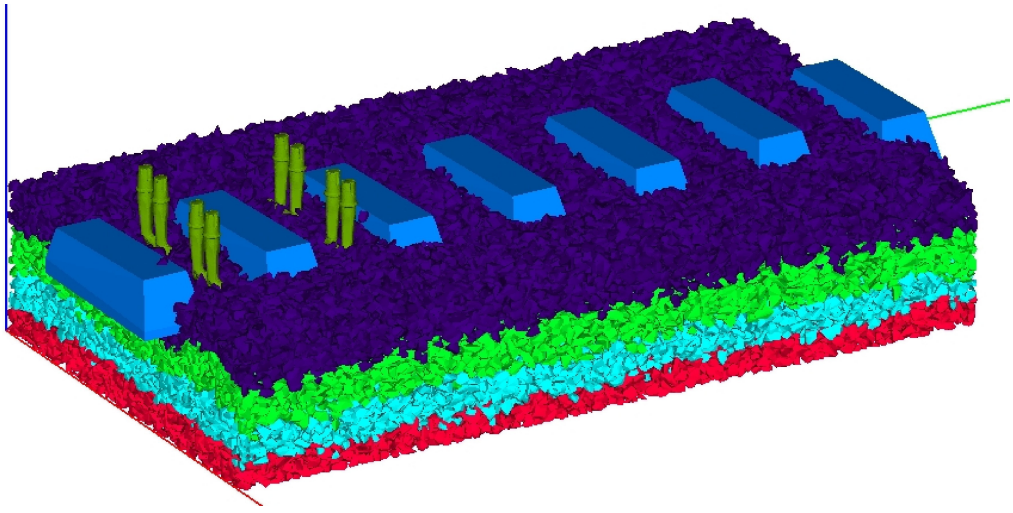

Figure: Tamping process around the second sleeper.