



HAL
open science

Domain decomposition for granular dynamics: scalability issue

Damien Iceta, David Dureisseix, Pierre Alart

► **To cite this version:**

Damien Iceta, David Dureisseix, Pierre Alart. Domain decomposition for granular dynamics: scalability issue. 4th European Conference on Computational Mechanics - ECCM2010, May 2010, Paris, France. hal-00502824

HAL Id: hal-00502824

<https://hal.science/hal-00502824v1>

Submitted on 24 Aug 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0
International License

Domain decomposition for granular dynamics: scalability issue

D. Iceta¹, D. Dureisseix¹, P. Alart¹

¹LMGC, University Montpellier 2 / CNRS UMR5508, France, {damien.iceta,david.dureisseix,pierre.alart}@lmgc.univ-montp2.fr

Numerical simulations of dense granular media lead, for various situations, to model the grains as rigid bodies, and to consider contact with friction for the interactions between grains (monuments, masonry, blocky rocks, geomaterial, ballasts, powders...) The dynamical evolution of such a collection of rigid bodies is non smooth, and dedicated numerical methods are available [1, 2].

When the number of grains is large (and the number of interactions even larger), the simulations are computationally intensive. In such cases, domain decomposition (DD) is expected to be an efficient computationally tool. The most efficient DD methods for mechanical problems are multilevel schemes [3, 4, 5, 6], but for the granular dynamics with rigid grains, no elliptical operators are involved, and the classical coarse space designs are not directly applicable. Indeed, even without coarse space, some monolevel DD methods may exhibit a behavior similar to scalability [7].

Though embedding a coarse space problem may be useful for deriving a numerical homogeneous constitutive law of a granular media, it is not obvious that the convergence rate will be significantly improved for such a problem, for which dynamics and non-smooth features may dominate the numerical behavior.

Preliminary results obtained in [7] are depicted in Figures 1 and 2, for which the indicator of convergence does not exhibit clearly a lack of scalability for a mono-level domain decomposition method. An enriched version of the domain decomposition strategy will be described and tested according to these topics.

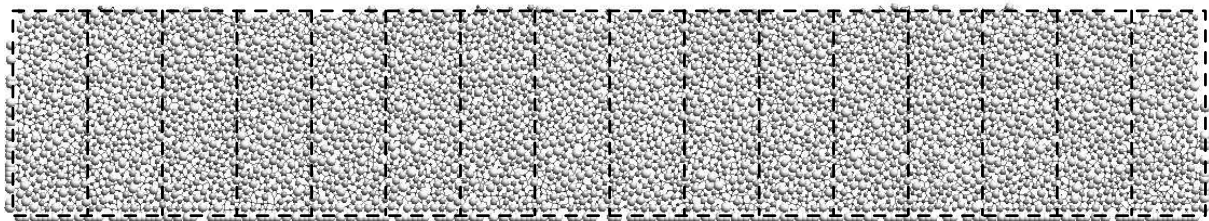


Figure 1: Granular media test case (shearing) with the grid used to split the domain into 16 subdomains

References

- [1] J. J. Moreau. Numerical aspects of sweeping process. *Computer Methods in Applied Mechanics and Engineering*, 177:329–349, 1999.
- [2] M. Jean. The non-smooth contact dynamics method. *Computer Methods in Applied Mechanics and Engineering*, 177:235–257, 1999.
- [3] C. Farhat, M. Lesoinne, P. Le Tallec, K. Pierson, and D. Rixen. FETI-DP: A dual-primal unified FETI method – Part I: A faster alternative to the two-level FETI method. *International Journal for Numerical Methods in Engineering*, 50(7):1523–1544, 2001.

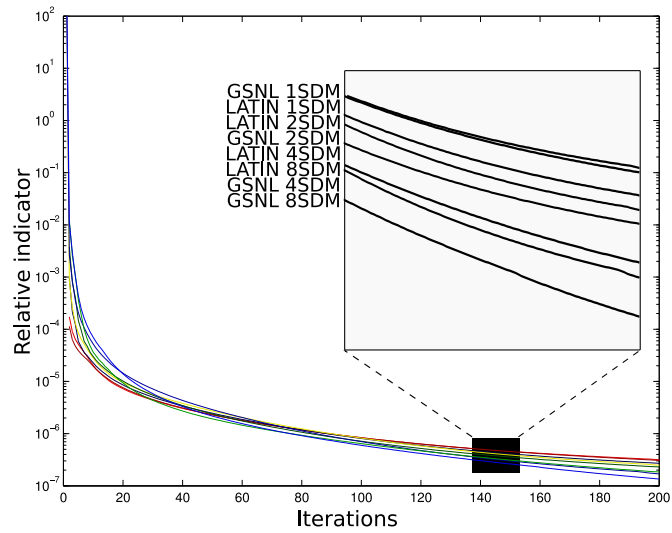


Figure 2: Evolution of the convergence indicator along iterations for various subdomain numbers

- [4] J. Mandel and C. Dohrmann. Convergence of a balancing domain decomposition by constraints and energy minimization. *Numerical Linear Algebra with Applications*, (10):639–659, 2003.
- [5] P. Ladevèze, O. Loiseau, and D. Dureisseix. A micro-macro and parallel computational strategy for highly heterogeneous structures. *International Journal for Numerical Methods in Engineering*, 52(1-2):121–138, 2001.
- [6] A. Klawonn and O. B. Widlund. Dual-primal FETI methods for linear elasticity. *Communications on Pure and Applied Mathematics*, LIX:1523–1572, 2006.
- [7] D. Iceta, D. Dureisseix, and P. Alart. Mixed versus impulse-oriented domain decomposition method for granular dynamics. *European Journal of Computational Mechanics*, 18(5-6):429–443, 2009.