POLITECNICO DI TORINO

DISMA Dipartimento di Scienze Matematiche G. L. Lagrange
ECCELLENZA 2018 · 2022

Wednesday the 20 June 2018 at 10:00
Politecnico di Torino, DISMA, Aula Buzano (third floor)

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An $\mathcal{H}$-matrix based Direct Solver for the Boundary Element Method in 3D Elastodynamics

Prof. Maria Vallarino moderates the discussion

Abstract

The Boundary Element Method (BEM) has emerged as an efficient alternative to all the classical domain methods to handle seismic wave propagation. The BEM is based on a boundary integral formulation, which requires the discretisation of the only domain boundaries, leading to a drastic reduction of the total number of Degrees of Freedom (DoF) of the problem. A major drawback of classical BEM is that it results in dense matrices, which lead to high memory requirement ($\mathcal{O}(N^2)$, if N is the total number of DoF) and computational costs. Therefore, number of DoF limits the simulation of realistic problems.

Several fast BEMs have been developed to improve the computational efficiency. In particular, the hierarchical matrix ($\mathcal{H}$-matrix) technique permits to approximate the fully-populated BEM matrix by a data-sparse one and to accelerate the classical matrix/vector product and matrix/matrix arithmetic, to define fast solvers for elastodynamic problems.

In this talk, a fast $\mathcal{H}$-matrix based direct BEM solver for 3D elastodynamic problems is proposed. If the reduction of storage cost is due to low-rank approximations computed by the innovative Vector Adaptive Cross Approximation (VACA), the reduction of the computational time to solve the system comes from an LU-factorization computed by using $\mathcal{H}$-matrix arithmetic. The numerical efficiency and accuracy of the method are assessed from numerical results obtained for benchmarks problems with exact solutions. In particular, Dr Deriderio will present a numerical study of the efficiency of low-rank approximations when the frequency is increased. The efficiency of the method is also illustrated to simulate an elastic half-space with or without topographic irregularities.

Biografy

After a Laurea in Mathematics from the University of Parma in 2013, Luca Desiderio moved to Paris and obtained his PhD in Applied Mathematics from Université Paris-Saclay in 2017.

His research focuses on numerical methods to simulate wave propagation phenomena in both frequency and time domains. Dr Desiderio is a Post-Doctoral Fellow at Politecnico di Torino.

Save the date for the next event: Wednesday the 27th of June 2018