Université Paris Saclay
CentraleSupélec, MICS & Nvidia GPU Research Center and ENS Paris-Saclay, LMPS
organize the thematic day on

Advances in Asynchronous Domain Decomposition Methods

Friday 12th of May 2023

Amphithéâtre Dorothy Hodgkin, ENS Paris Saclay, 4 Av. des Sciences, 91190 Gif-sur-Yvette

This one-day event is designed to present the latest advances on asynchronous domain decomposition methods. The program is the following.

10:00 - 10:50 Talk

Speaker : Mohammed Amine Rahhali, Thierry Garcia, **Pierre Spiteri** (ENSEEIHT, Toulouse, France)

Title : Behavior of asynchronous subdomain method implemented on cloud computing for the numerical solution of PDE

Abstract : Parallel iterative algorithms are computing methods in which the communications can be synchronized or not at the end of each iteration. When the convergence is slow, in synchronous parallel iterative algorithms, given a heterogeneous distributed architecture, the idle times of the processing units will degrade the performance and elapsed times will be penalized. In asynchronous parallel iterative algorithms, the calculations are processed on each processor respecting the own rhythm of each processing unit and using the last available values calculated by the other processors. So, the advantage lies in the fact that there is generally a reduction in the elapsed time to reach convergence. In previous studies these methods were implemented on grids constituted by heterogeneous and distant machines and asynchronous algorithms were very efficient when there was lots of synchronizations between the processors. This talk investigates the implementation of these two kinds of methods and their comparison on a Cloud computing architecture with several sizes of algebraic systems derived from the discretization of linear boundary values problem to be solved. It can be noticed that, in this context and for the resolution of linear classical boundary values problems, the asynchronous computation scheme gives better results than the synchronous scheme.

10:50 - 11:00 Coffee break

11:00 - 11:50 Talk

Speaker : **Daniel B. Szyld** (Temple University, Philadelphia, USA)

Title : One- and Two-level Asynchronous Optimized Schwarz Methods for the solution of PDEs

Abstract : For the numerical solution of a general partial differential equation on a domain, Schwarz iterative methods use a decomposition of the domain into two or more (overlapping) subdomains. In essence one is introducing new artificial boundary conditions on the interfaces between these subdomains. In the classical formulation, these artificial boundary conditions are of Dirichlet type. In the case of optimized Schwarz, the boundary conditions on the artificial interfaces are of Robin or mixed type. In this way one can optimize the Robin parameter(s) and obtain a very fast method. Instead of using this method as a preconditioner, we use it as a solver, thus avoiding the pitfall of synchronization required by the inner products. In this talk, an asynchronous version of the optimized Schwarz method is presented for the solution of differential equations on a parallel computational environment. An additive coarse grid correction is added and one obtains a scalable method. Several theorems show convergence for particular situations. Numerical results are presented on large three-dimensional problems illustrating the efficiency of the proposed asynchronous parallel implementation of the method.

12:00 - 14:00 Lunch break

14:00 - 14:45 PhD thesis defense

Speaker : **Ahmed El Kerim** (ENS Paris Saclay, CentraleSupélec, Gif-sur-Yvette, France)

Title : Asynchronous domain decomposition method in structural mechanics -- case of the global/local coupling

Abstract : A new asynchronous version of the global/local non-intrusive coupling method is presented, which can efficiently handle multiple possibly adjacent patches. First, a new interpretation of the coupling as a right preconditioned primal domain decomposition method is presented. The convergence of the relaxed asynchronous iteration is then demonstrated for both linear and nonlinear monotone cases using Paracontraction techniques. An implementation based on MPI-RDMA techniques is presented and compared with an accelerated synchronous method. The method is illustrated on several linear elliptic problems, such as those encountered in thermal and elasticity studies and on nonlinear elastoplasticity problems.

14:45 – 17:00 Discussion with the committee

Registrations :
Participation at the event is free of charge, but registration is compulsory. People should register by sending an email to frederic.magoules at centralesupelec.fr.

Contacts :
Pierre Gosselet (Univ. Lille, LabMcube, CNRS)
Frédéric Magoulès (Univ. Paris Saclay, CentraleSupélec, MICS)