

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

M. A. Rahhali¹, T. Garcia², P. Spiteri³

¹Department ENGIE,

²Department of Computer Sciences,

³Department of Mathematical Sciences,

Abstract

Parallel iterative relaxation algorithms are computing methods in which the communications can be synchronized or not at the end of each iteration. Given an heterogeneous distributed architecture when the convergence is slow, in synchronous parallel iterative algorithms the idle times of the processing units will degrade the performance of parallel algorithms and elapsed times will be penalized. When the communications are asynchronous the calculations are processed on each processor respecting the own rhythm of each processing unit and using the last available values computed by the other processors. So, the main advantage of using such asynchronous methods lies in the fact that there is generally a reduction of the elapsed time of computation to reach convergence.

In previous studies these methods are implemented first on clusters and then on grids constituted by heterogeneous and distant machines. During these previous parallel experiments it can be observed that asynchronous algorithms are very efficient when there was a large lot of synchronization between the processors. Then it was observed that asynchronous variants gave better elapsed times of computation on grid-type architectures due to slow communications between processors since the bandwidth is shared by others machines. Indeed in synchronous case latencies penalize and affect the simulation elapsed time. Moreover, this effect is increased by the geographical distance between the machines and also, when nodes are heterogeneous which is the case for example with grids or cloud computing.

Then, in the present talk we will consider an implementation on cloud architecture applied to the solution of discretized linear diffusion and convection-diffusion problems which allows us to analyze the behavior of the two target algorithms. Given the fact that this last type of architecture includes additional software layers, we verify experimentally that the implementation of iterative asynchronous methods give better results in terms of work restitution time than the synchronous version. So, for the numerical solution of both boundary values problems, using these two variants of communications, we compare the elapsed time to reach convergence. In this computational context, it can be noticed that the asynchronous computation scheme gives better elapsed times than the synchronous scheme for the numerical solution of these classical problems arising in more complex applications. Parallel experiments was first performed on virtual machines and then on FG-Cloud which offers users cloud services that allow on-demand computation, storage and networking dedicated to the scientific community and algorithm testing. So results of parallel experiments will be presented and analyzed
