Study and design of pipelined Block Krylov linear solvers

Post-doctoral project - 2017/2018
HiePACS*project-team, Inria Bordeaux-Sud Ouest

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1 Scientific context

The HiePACS team at Inria Bordeaux-Sud Ouest has been studying and developing Krylov linear solvers and associated software packages for the past few years with a recent emphasis on block Krylov methods enabling to solve multiple right-hand sides simultaneously [4]. Such linear systems arise in many large scientific and industrial applications, such as in radar cross section calculation in electromagnetism, wave scattering and wave propagation in acoustics, various source locations in seismic and parametric studies in general. These numerical methods exhibit attractive computational features in term of memory access; basically BLAS-3 type of operations compared to rather BLAS-1 calculation for their single right-hand side counterpart. Their parallel scalability can significantly be improved by accommodating pipelining ideas developed so far for single right-hand side [5].

2 Objective of the work

The objective of this post-doctoral project is twofold. First, extend the pipelining ideas from single right-hand side to the multiple-right-hand side framework. This study will first be conduced in the context of regular BGMRES, the possible extension to more advanced solution techniques with inexact breakdowns and deflation at restart will then be considered [4].

The second expected contribution is the implementation of these new numerical schemes in our software package Fabulous [1]. The performance validation at scale will be performed via the integration of these new solvers in either MaPhys [2] or PaStiX [3] in application context in collaboration with our industrial partners, namely Airbus, CEA or Total, as well as other Inria teams we collaborate with, namely Magique3D and Nachos.

3 Bakground

This position is intended for candidates with a strong background in computational sciences, preferably holding a PhD in applied mathematics or computer science, with some knowledge in numerical linear algebra. A knowledge/experience of parallel programming would also be appreciated.

*https://team.inria.fr/hiepacs/

4 Supervision and starting date

The postdoc will work closely with Emmanuel Agullo and Luc Giraud (HiePACS project-team). Some meetings with other Inria teams (current or potential users of the MaPHyS and PaStiX software) will be organized as well to fully assess the decision made in the numerical and implementation design.

This 12-18 month position is planned to start on December 1st, 2017 at the latest.

In order to apply, send a CV, reference letter and the contact details of 2 or 3 academic references to Emmanuel.Agullo@inria.fr or Luc.Giraud@inria.fr.

5 References

[1] Fabulous package

[2] MaPHyS package

[3] PaStiX package

[4] E. Agullo, L. Giraud, Y.-F. Jing
Block GMRES method with inexact breakdowns and deflated restarting, SIAM Journal on Matrix Analysis and Applications 35, 4, November 2014, p. 1625–1651,

[5] P. Ghysels, T.J. Ashby, K. Meerbergen, and W. Vanroose.
Hiding global communication latency in the GMRES algorithm on massively parallel machines. SIAM Journal on Scientific Computing, 35(1):C48–C71, 2013.