Discrete time analysis for domain decomposition

Arthur Arnoult*[1]

[1]Université Sorbonne Paris Nord – Université Paris XIII - Paris Nord – France

Abstract

Optimized Schwarz waveform relaxation (OSWR) is a domain decomposition algorithm for solving partial differential equations on small subdomains in order to accelerate numerical resolution. This poster shows a new approach, that provides new results in the convergence analysis of OSWR iterations for parabolic problems.
This new approach relies on the time discretization of the domain decomposition equations with backward Euler, in order to obtain a system of differential equations that can be analytically solved. Contrary to the classical method that choses the Robin parameter that minimizes the contraction ratio of the Fourier transform of the continuous in time solution, this method minimizes the contraction matrix norm of the discrete time solution.

This method allows to define efficient optimized Robin parameters that depend on the targeted iteration count, a property that is shared by the actual observed optimal parameters, while traditional Fourier analysis in the time direction leads to iteration independent parameters.
Numerical results show that this parameter is an accurate estimation of the optimal Robin parameter, which allows to perform the smallest number of iterations possible.

*Speaker

Partial and full improvement of the convergence of the Bl-BiCG and Bl-BiCGStab methods

Fatima Bouyghf*[1]

[1]Laboratoire de Mathématiques Nicolas Oresme – Université de Caen Normandie, Centre National de la Recherche Scientifique – France

Abstract

In this poster, we present a technique to improve the convergence of the block version of some Krylov methods for solving non-symmetric linear systems of equations with multiple right-hand sides. Especially, short-recurrence type methods. This technique is inspired from the famous block GMRES method (Bl-GMRES). Using orthogonal projectors to minimize the norm of the residual matrix computed in each method. The considered methods are block BiCG (Bl-BiCG) and block BiCGStab (Bl-BiCGStab) methods. To show the performance of our enhanced algorithms, we compare them with the Bl-GMRES method as the most optimal method in terms of precision.

*Speaker

One-shot domain decomposition methods for component-based model order reduction

Giulia Sambataro*[1], Angelo Iollo[2], and Tommaso Taddei[2]

[1]CERMICS – Ecole des Ponts ParisTech, Inria Paris – France
[2]Inria Bordeaux South-West – INRIA Bordeaux South-West, Université de Bordeaux (Bordeaux, France) – France

Abstract

We propose a component-based (CB) parametric model order reduction (pMOR) procedure for a class of problems in nonlinear mechanics with internal variables. The work is is motivated by applications to thermo-hydro-mechanical (THM) systems for radioactive waste disposal. The solution to this coupled system depends on several parameters, which might be related to the geometric configuration (e.g. the number of repositories, their distance or their size) or the material properties of the medium. The CB-pMOR formulation is based on overlapping subdomains. We first devise a constrained optimization procedure that minimizes jumps at components' interfaces subject to the (approximate) satisfaction of the PDE in each component. Then, we introduce suitable low-dimensional control variables to recast the optimization problem into an unconstrained nonlinear least-square problem that can be effectively solved using the Gauss-Newton method.

*Speaker

Convergence analysis of multi-step one-shot methods for linear inverse problems

Marcella Bonazzoli* , Houssem Haddar* , and Tuan Anh Vu*[1]

[1]École Nationale Supérieure de Techniques Avancées – MESRI – France

Abstract

In this work we are interested in general linear inverse problems where the corresponding forward problem is solved iteratively using fixed point methods. Then one-shot methods, which iterate at the same time on the forward problem solution and on the inverse problem un- known, can be applied. We analyze two variants of the so-called multi-step one-shot methods and establish sufficient conditions on the descent step for their convergence, by studying the eigenvalues of the block matrix of the coupled iterations. Several numerical experiments are provided to illustrate the convergence of these methods in comparison with the classical usual and shifted gradient descent. In particular, we observe that very few inner iterations on the forward problem are enough to guarantee good convergence of the inversion algorithm.

*Speaker