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Acceleration of the Schwarz Method for Elliptic Problems

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Abstract: The Schwarz algorithm has two important qualities that make its use in Computational Fluid Dynamic applications very attractive. First, the method is very easy to implement. A popular practice in CFD is to start from an existing code, partition the domain of computation into overlapping sub-domains, run the CFD solvers in parallel between sub-domain and exchanges information on artificial boundaries between neighbor's sub-domains at the end of each iteration cycle in order to match the solution or some fluxes. This practice avoids a complete re-writing of the CFD code, but convergence of the algorithm might be (very) slow.
The second important quality of the Schwarz algorithm is that (memory) scalability of the iteration step in a parallel implementation is implicitly given thanks to the fact that communications are always between neighbor's sub-domains. But as pointed out in Keyes - Domain Decomposition Proceeding of 98-, the numerical algorithm does not scale at all, because the number of iterates to reach convergence increases as the number of sub-domains increases.
In this paper, we present a family of domain decomposition based on Aitken like acceleration of the Schwarz method seen as an iterative procedure with linear rate of convergence. This paper is a generalization of our method first introduced in the 12th international conference on domain decomposition [2000] that was restricted to Cartesian grids. The general idea is to construct an approximation of the eigenvectors of the trace transfer operator that have the dominant eigenvalues and accelerate these components after few Schwarz iterates. We consider here examples with the finite volume approximation on general quadrangle meshes of Faille [1992], finite differences with non matching grids and Finite element discretisation.

[1] J. Baranger, M. Garbey and F. Oudin-Dardun, *On Aitken Like Acceleration of Schwarz Domain Decomposition Method Using Generalized Fourier*, to appear in the proceeding of DD14.

[2] N. Barberou, M. Garbey, M. Hess, M. Resch, T. Rossi, J. Toivanen and D. Tromeur Dervout, *On the Efficient Meta-computing of linear and nonlinear elliptic problems*, to appear in the Journal of Distributed Parallel Computing: special issue on grid computing.

[3] M. Garbey and D. Tromeur Dervout: *On some Aitken like acceleration of the Schwarz Method*, Int. J. for Numerical Methods in Fluids. 40 (12), pp 1493-1513, 2002.

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