AMG Preconditioners based on parallel hybrid coarsening exploiting multi-objective graph matching

Fabio Durastante
University of Pisa, Pisa (Italy)
fabio.durastante@unipi.it

In this talk, we describe preliminary results from a multi-objective graph matching algorithm, in the coarsening step of an aggregation-based Algebraic MultiGrid (AMG) preconditioner, for solving large and sparse linear systems of equations on high-end parallel computers. On one hand, we focus on the task of improving the convergence behavior of the AMG method when applied to highly anisotropic problems. On the other hand, we describe the first step towards the extension of the parallel package `AMG4PSBLAS` [1] to exploit multi-threaded parallelism at the node level on multi-core processors. The proposed matching approach balances the need to simultaneously compute high weights and large cardinalities in the matching by a new formulation of the weighted matching problem that combines both these objectives using a parameter λ. The matching is computed by a parallel $2/3-\varepsilon$-approximation algorithm for maximum weighted matchings [2,3]. The results show that the new matching algorithm with a suitable choice of the parameter λ computes effective preconditioners in the presence of anisotropy.

Joint work with P. D'Ambra, S. M. Ferdous, S. Filippone, M. Halappanavar*, and* A. Pothen

References

[1] P. D'Ambra, F. Durastante and S. Filippone, *AMG Preconditioners for Linear Solvers towards Extreme Scale*, SIAM J. Sci. Comput. **43**, 2021, no. 5, pp. S679–S703.

[2] S M Ferdous, Algorithms for degree-constrained sub-graphs and applications, Ph.D. thesis, Purdue University, West Lafayette, IN, USA, 2021.

[3] F. Manne and M. Halappanavar, *New Effective Multithreaded Matching Algorithms*, Proceedings of IEEE 28th IPDPS, 2014, pp. 519–528.