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**Algebraic multigrid for contact problems in saddle point
formulation**

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This talk introduces a full aggregation-based algebraic multigrid strategy for structural contact problems in saddle point formulation (e.g., [1, 2]). The basic idea is to preserve the saddle point structure on all multigrid levels. This concept of extending multigrid methods to saddle point systems is not new and can be found, e.g., in the context of Stokes and Oseen equations in [3]. So far, there is not so much literature on aggregation-based algebraic multigrid solvers for mortar-based contact problems.

The main contribution of this work is the development of an interface aggregation strategy for generating the Lagrange multiplier aggregates that are required for coupling the structural equations with the contact constraints. The proposed method is simpler to implement, computationally less expensive than the ideas from [4], and – in the author’s opinion – the presented approach is more intuitive for contact problems. Our interface aggregation strategy perfectly fits into the general multigrid framework and can easily be combined with segregated transfer operators which allow to preserve the saddle point structure on the coarse levels (cf. [5]). Numerical experiments show the robustness of the new method.

Bibliography

- [1] C. Wieners and B. Wohlmuth: *Duality estimates and multigrid analysis for saddle point problems arising from mortar discretizations*. SIAM Journal on Scientific Computing, vol 24, 2163-2184, 2003.
- [2] A. Popp: *Mortar Methods for Computational Contact Mechanics and General interface Problems*. Technische Universität München, 2012.
- [3] Ales Janka: *Smoothed aggregation multigrid for a Stokes problem*, Institute of Analysis and Scientific Computing, Ecole Polytechnique Federale de Lausanne, 2006.
- [4] M. F. Adams: *Algebraic multigrid methods for constrained linear systems with applications to contact problems in solid mechanics*. Numerical Linear Algebra with Applications, vol 11, 141-153, 2004
- [5] T. A. Wiesner: *Flexible aggregation-based algebraic multigrid methods for contact and flow problems*. Technische Universität München, 2015.