Collocation for the Boundary Element Method of Linear Elasticity

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Using the boundary element method to solve mixed boundary value problems generally results in non-sparse matrices. To reduce storage, we approximate the involved operators by hierarchical matrices [1].

Furthermore, to speed up simulation we would like to replace the Galerkin method by collocation for the discretisation of the operators.

The standard formulation of the boundary integral equations involves a hypersingular integral operator, which is not defined in the case of collocation. In order to overcome this problem and to avoid the mentioned operator, we will use a mixed approximation which was introduced by Olaf Steinbach for the Laplace equation [2]. With the help of the Steklov-Poincaré operator a coupled saddle point problem can be derived only involving single and double layer potential operators. To ensure stability, two nested grids need to be combined for the discretization of the integral operators.

Our aim is the application of this mixed formulation together with collocation to the Lamé equation from linear elasticity.

As optimization, we additionally introduce a symmetrization scheme for the involved non-symmetric matrix together with a preconditioner. Finally we perform a parameter study in order to find the optimal parameters in terms of the computation of the hierarchical matrices.

By this means we aim to speed up the overall simulation.

References

[1] Mario Bebendorf. *Hierarchical Matrices*, Springer, 2008.

[2] Olaf Steinbach. *Mixed approximations for boundary elements*, SIAM J. Numer. Anal., 38(2), pp. 401-413, 2000.