# Robust BDDC preconditioners for Reissner-Mindlin plate and Naghdi shell problems

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We construct and study some Balancing Domain Decomposition Methods by Constraints (BDDC) for Reissner-Mindlin plate bending problems and Naghdi shell problems, discretized with MITC (Mixed Interpolation of Tensorial Components) finite elements.

In addition to the standard properties of scalability in the number of subdomains $N$, quasi-optimality in the ratio $H/h$ of subdomain/element sizes, and robustness with respect to discontinuities of the material properties, our goal here is to obtain robustness also with respect to the additional small parameter $t$ representing the plate or shell thickness. This is a challenging issue since the condition number of plates and shell problems diverges as $O(t^{-2})$ as $t$ tends to zero.

The proposed BDDC preconditioners are based on a proper selection of primal continuity constraints, the implicit elimination of the interior degrees of freedom in each subdomain, and the iterative solution of the resulting plate or shell Schur complement by a preconditioned conjugate gradient method. Each preconditioner is built from the solutions of local plate or shell problems on each subdomain with clamping conditions at the primal degrees of freedom and on the solution of a coarse plate or shell problem for the primal degrees of freedom.

For Reissner-Mindlin plates, we can prove that the proposed BDDC algorithm is scalable, quasi-optimal, and, most important, robust with respect to the plate thickness. While this result is due to an underlying mixed formulation of the problem, both the interface plate problem and the preconditioner are positive definite. Numerical results also show that the proposed algorithm is robust with respect to discontinuities of the plate material properties.

For Naghdi shells, we do not have a theoretical bound but several numerical tests show that the proposed BDDC preconditioners are scalable, quasi-optimal, robust with respect to discontinuities of the shell material properties, and almost robust with respect to the shell thickness.