BDDC Domain Decomposition Algorithms

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When designing domain decomposition algorithms, approximate inverses, known as preconditioners, are constructed for very large matrices by using solvers for smaller instances of the given problem. The problems considered often arise in continuum mechanics, e.g., in linear elasticity or electro-magnetics. The preconditioners are typically combined with Krylov space methods to accelerate the convergence. In addition, to obtain fast convergence with a rate of convergence independent of the number of local problems, a coarse component of the preconditioners is often needed. The construction of effective coarse components with only a few degrees of freedom is the core issue in many studies of domain decomposition algorithms.

The BDDC algorithms (Balancing Domain Decomposition by Constraints) were introduced by Clark Dohrmann and have proven very successful in many applications and they are now supported by many studies and by publicly available PETSc software. These algorithms are closely related to the FETI—DP algorithms that predate them. There are many studies for a variety of finite element problems as well as for mortar methods, spectral elements, and, in recent years, for isogeometric analysis.

The basic BDDC algorithms will be introduced as well as its deluxe variant. An introduction will be given to adaptive algorithms which can automatically construct effective coarse components of the preconditioners at a cost of solving local eigenvalue problems. Examples from different applications will
also be provided.