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Algebraic multigrid domain decomposition methods. (English) [Zbl 0825.65091]

Summary: The paper treats a new approach to constructing multilevel preconditioners for symmetric, positive definite and semi-definite matrices which arises in approximating elliptic problems by finite difference and finite element methods. The approach is based on multilevel domain decomposition methods with partitionings into small substructures and with inner Chebyshev iterative procedures. The paper shows that in the case of model elliptic boundary value problems, the iterative methods with the constructed preconditioners can be referred at the same time to the class of multigrid methods. Due to this fact these methods are called multigrid domain decomposition methods (MGDD-methods). The estimates of the convergence rate for the methods and of the computational cost of their realization are constructed for these model elliptic problems.

MSC:

65N55 Multigrid methods; domain decomposition for boundary value problems involving PDEs
65N30 Finite element, Rayleigh-Ritz and Galerkin methods for boundary value problems involving PDEs
65N06 Finite difference methods for boundary value problems involving PDEs
65F10 Iterative numerical methods for linear systems
65F35 Numerical computation of matrix norms, conditioning, scaling
35J25 Boundary value problems for second-order elliptic equations

Keywords:
multilevel preconditioners; elliptic problems; finite difference; finite element methods; multilevel domain decomposition methods; Chebyshev iterative procedures; iterative methods; multigrid methods; convergence