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A ROBUST AND PARALLEL MULTIGRID METHOD FOR CONVECTION DIFFUSION EQUATIONS*

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Abstract.
We present a multigrid method for the solution of convection diffusion equations that is based on the combination of recursive substructuring techniques and the discretization on hierarchical bases and generating systems. Robustness of the resulting method, at least for a variety of benchmark problems, is achieved by a partial elimination of couplings between certain "coarse grid unknowns".

The choice of these coarse grid unknowns is motivated by the physical properties of the convection diffusion equation, but it is independent of the actual discretized operator. The resulting algorithm has a memory requirement that grows linearly with the number of unknowns; likewise do the computational costs of the setup and of the individual relaxation cycles. We present numerical examples that indicate that the number of iterations needed to solve a convection diffusion equation is also substantially independent of the number of unknowns and of the type and strength of the convection field.

Key words. convection diffusion equation, multigrid, substructuring method, parallelization

AMS subject classifications. 65N55, 76R99, 65Y05

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