SURVEY and REVIEW

The Survey and Review article in this issue is "A Class of Iterative Solvers for the Helmholtz Equation: Factorizations, Sweeping Preconditioners, Source Transfer, Single Layer Potentials, Polarized Traces, and Optimized Schwarz Methods," by Martin J. Gander and Hui Zhang. The Helmholtz equation appears in the study of time-harmonic waves $u(\mathbf{x})\exp(-i\omega t)$ arising in acoustics, electromagnetism, and other fields. In its simplest form the equation reads $(\Delta+k^2)u = f$, where Δ denotes the Laplacian operator and the constant k is the wavenumber, and therefore is reminiscent of the Poisson equation $\Delta u = f$. However, this similarity is only superficial, and the numerical solution of boundary value problems, often posed in unbounded domains, involving the Helmholtz equation is challenging. Classical iterative solvers are not suitable, and the recent literature has devoted much effort to the development of novel solvers. New iterative methods have been suggested by authors with a wide range of backgrounds and motivations and invoke different discretization strategies; some of them have been formulated at the linear algebra level and others at the level of the differential equation. Gander and Zhang survey the new developments using a unifying point of view. The main insight is given in section 2: the forward and backward substitution sweeps of the block LU factorization of the discrete system correspond at the continuous level to sweeps from left to right and right to left of an optimal Schwarz domain decomposition method. The article will be useful not only to those working directly with the Helmholtz and related partial differential equations, but also to anybody interested in iterative solvers for large linear systems.

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