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A new convergence proof of an iterative method for elliptic Cauchy problems

Abstract

We consider an elliptic Cauchy problem for the Poisson equation in which both Dirichlet and Neumann boundary data are prescribed only on a portion of the boundary, while no boundary conditions are available on the remaining part of the boundary. Such problems are typically ill-posed, making the development of stable and computationally efficient methods challenging. In this work, we investigate an iterative approach based on alternating Dirichlet and Neumann boundary conditions. The proposed scheme is formulated within a Hilbert space framework, where each iteration can be interpreted as an orthogonal projection onto an appropriate closed subspace. This orthogonal formulation provides a clear geometric interpretation of the algorithm and allows its convergence properties to be established through the theory of alternating projections. Our analysis gives insight into the behavior of the iterative process and provides a systematic framework for studying convergence.

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