ADAPTIVE FRAME METHODS FOR MAGNETOHYDRODYNAMIC FLOWS

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ABSTRACT. In this paper we develop adaptive numerical schemes for certain nonlinear variational problems. The discretization of the variational problems is done by a suitable frame decomposition of the solution, i.e., a complete, stable, and redundant expansion. The discretization yields an equivalent nonlinear problem on $\ell_2(\mathcal{N})$, the space of frame coefficients. The discrete problem is then adaptively solved using approximated nested fixed point and Richardson type iterations. We investigate the convergence, stability, and optimal complexity of the scheme. This constitutes a theoretical advantage, for example, with respect to adaptive finite element schemes for which convergence and complexity results are usually hard to prove. The use of frames is further motivated by their redundancy, which, at least numerically, has been shown to improve the conditioning of the corresponding discretization matrices. Also frames are usually easier to construct than Riesz bases. Finally, we show how to apply the adaptive scheme we propose for finding an approximation to the solution of the PDE governing magnetohydrodynamic (MHD) flows, once suitable frames are constructed.

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