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TOWARDS ROBUST 3D Z-PINCH SIMULATIONS: DISCRETIZATION AND FAST SOLVERS FOR MAGNETIC DIFFUSION IN HETEROGENEOUS CONDUCTORS.**

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Abstract. The mathematical model of the Z-pinch is comprised of many interacting components. One of these components is magnetic diffusion in highly heterogeneous media. In this paper we discuss finite element approximations and fast solution algorithms for this component, as represented by the eddy current equations. Our emphasis is on discretizations that match the physics of the magnetic diffusion process in heterogeneous media in order to enable reliable and robust simulations for even relatively coarse grids. We present an approach based on the use of exact sequences of finite element spaces defined with respect to unstructured hexahedral grids. This leads to algorithms that effectively capture the physics of magnetic diffusion. For the efficient solution of the ensuing linear systems, we consider an algebraic multigrid method that appropriately handles the nullspace structure of the discretization matrices.

Key words. Maxwell's equations, eddy currents, De Rham complex, finite elements, AMG.

AMS subject classifications. 76D05, 76D07, 65F10, 65F30

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