REFLECTIONLESS DISCRETE PMLS FOR HIGH-ORDER FINITE DIFFERENCE SCHEMES AND FINITE ELEMENT METHODS

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Abstract. We introduce discrete-holomorphic Perfectly Matched Layers (PMLs) specifically designed for high-order finite difference (FD) and continuous, piecewise linear finite element discretizations of the scalar wave equation. In contrast to standard PDE-based PMLs, the proposed methods achieve the remarkable outcome of completely eliminating numerical reflections at the PML interface, in practice achieving reflection errors at the level of machine precision. Our approach builds upon the ideas put forth in a recent publication [1] expanding the scope from the standard second-order FD method to arbitrary high-order FD schemes [2] and the continuous, piecewise linear finite element method (FEM). Our RDPML-FEM method directly leverages the properties of the RDPML-FD method by combining standard FEM discretizations with Mass Lumping FEM [3] for the wave equation.

Keywords: Wave equation, Helmholtz equations, Perfectly Matched Layer, absorbing boundary condition, non-reflecting boundary condition, finite difference method, finite element method.

Mathematics Subject Classifications (2010): 65M60, 78A40, 76B15, 35L05.

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