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BOUNDARY LAYERS AND DISCONTINUITY OF MAGNETIC FIELDS

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Abstract. Numerical modeling of discontinuous distributions of magnetic field in multi-media domains has been one the greatest challenges in Computational Electromagnetics. We present a single-region approach based upon boundary layers - a method that has been proved effective in the literature of fluid dynamics to address strong field gradients - to model the discontinuity of magnetic fields. We compare it against a multi-region approach, where the magnetic field at the multi-media interface is evaluated as boundary conditions for each region. The numerical solvers were implemented in the open source platform OpenFOAM; both approaches were compared with orthogonal meshes, covering a variety of numerical experiments. We found that the discontinuity at the interface can be well modeled with a single-region approach and a boundary layer of at least two elements. The minimum number of elements for the boundary layer needed in order to correctly represent the discontinuity is found experimentally. Experiments also show that the single-region formulation is computationally more effective than the multi-region one. Our study addresses the computational effectiveness of boundary layers for analyzing the discontinuous interaction between different mediums, making it possible to use numerically simpler formulations in cases with irregular boundary conditions and obtaining accurate results.