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Harish Subrahmanya Bhat* (hbhat@ucmerced.edu), 5200 N. Lake Rd., School of Natural Sciences, Merced, CA 95343. *Synthesis of two-dimensional electromagnetic media that achieve desired transfer functions.*

Consider Maxwell's equations in a two-dimensional, rectangular, inhomogeneous electromagnetic medium. If the permittivity and permeability everywhere in the medium are known, then we define the transfer function to be the operator that relates spatially varying, time-harmonic forcing on the left boundary to the steady-state solution on the right boundary. In this paper, we consider the inverse problem: to solve for the permittivity and permeability in a domain such that a prescribed transfer function is achieved. The problem is naturally posed as an optimization problem, for which the existence of minimizing sequences will be discussed. The continuum problem can be discretized in space using the method of finite volumes, resulting in an interesting design problem for an analog circuit comprising inductors, capacitors, and resistors. This discrete problem can be attacked using Newton and quasi-Newton methods; analytical expressions for gradients and Hessians can be computed using adjoint variables. We present numerical results that demonstrate the efficacy of the method, and we discuss potential applications in engineering. (Received September 23, 2010)