

Far Field Broadband Approximate Cloaking for the Helmholtz Equation with a Drude-Lorentz Refractive Index

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We present the analysis of a passive, broadband approximate cloaking scheme for the Helmholtz equation. Using ideas from transformation optics, we construct an approximate cloak by “blowing up” an arbitrary small ball to a ball of radius one. In the anisotropic cloaking layer resulting from the “blow-up” change of variables, we incorporate a Drude-Lorentz-type model for the index of refraction, and we assume that the cloaked object is a soft (perfectly conducting) obstacle. We first show that there are no real transmission eigenvalues associated with the inhomogeneity representing the cloak, which implies that the cloaking devices we have created will not yield perfect cloaking at any frequency, even for a single incident time harmonic wave. Secondly, we establish estimates on the scattered field due to an arbitrary time harmonic incident wave. These estimates show that, as the radius of the small ball approaches zero, the L²-norm of the scattered field outside the cloak, and its far field pattern, approach zero uniformly over any bounded band of frequencies. In other words: our scheme leads to broadband approximate cloaking for arbitrary incident time harmonic waves. This is a joint work with Narek Hovsepyan and Michael Vogelius.