Cloaking by Reaction through Plasmonic Resonance

R.C. McPhedran, G.W. Milton, N.A. Nicorovici , and L.C. Botten,
CUDOS, School of Physics, University of Sydney, Sydney, NSW, Australia,
Department of Mathematics, University of Utah, Salt Lake City, Utah,USA,
Department of Mathematical Sciences, University of Technology Sydney, Sydney, NSW, Australia

There is much current interest in electromagnetic cloaking of objects, by exploiting structured materials. One approach cloaking by refraction, has been pioneered by J.B. Pendry [1] and U. Leonhardt [2], and exploits metamaterials to create electromagnetic guiding around the region to be shielded. A second approach [3,4] ,cloaking by reaction, uses electromagnetic resonances in a coated cylinder, designed to have a resonant interaction between its coating and the surrounding material, to quench polarization responses in dipoles within an analytically-determined cloaking region surrounding the cylinder . We have extended the treatment of [4] to include interacting systems of polarizable dipoles or quadrupoles, and present animations illustrating that resonant cloaking still works for complicated assemblies of dipoles, or for higher order multipoles, and that the cloaking region does not depend on the details of the entity to be cloaked. We also give simulation results showing that cloaking is successful for cylinders coated with silver, at a near-ultraviolet wavelength, assuming the quasistatic limit to hold, and using the actual optical constants for silver. We comment on the design parameters necessary for reactive cloaking schemes to work with realistic materials.

[1] J.B. Pendry, D. Schurig, and D.R. Smith, *Science*, 31**2**, 1780 (2006).
[2] U. Leonhardt, *New J. Phys.*, 8, 118 (2006).
[3] N.A. Nicorovici, R.C. McPhedran, and G.W. Milton, *Phys. Rev. B*, 49, 8479 (1994).
[4] G.W. Milton, and N.A. Nicorovici, *Proc. Roy. Soc. A*, 462, 3027 (2006).