Cloaking: a new phenomenon in electromagnetism

Graeme MILTON, University of Utah, USA
Nicolae-Alexandru P. NICOROVICI, University of Sydney, Australia

The making of an object invisible through some cloaking device is commonly regarded as science fiction. But we have found that, after a sufficient period of time, superlenses can cause objects near them to become essentially invisible through localized resonances generated by the interaction of the object (assumed to be a finite collection of polarizable point dipoles) and the superlens. Cloaking occurs when the resonant field generated by a polarizable line or point dipole acts back on the polarizable line or point dipole and effectively cancels the field acting on it from outside sources, so it has essentially no response to the external field. Numerically we see that the polarizable line or point dipole is effectively invisible to the external time harmonic field. Cloaking is proved in the quasistatic limit for finite collections of polarizable line dipoles that all lie within a specific distance from a coated cylinder having a shell dielectric constant close to -1 and a matrix and core dielectric constant close to 1. Cloaking is also shown to extend to the Veselago superlens for the full Maxwell equations: a polarizable line dipole located less than a distance d/2 from the lens, where d is lens thickness, will be cloaked due to the presence of a resonant field in front of the lens. Also a polarizable point dipole near a slab lens will be cloaked in the quasistatic limit. The hope of using cloaking to see the interior of an object by making half of it invisible remains an intriguing possibility.

References

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Graeme MILTON – milton@math.utah.edu
Department of Mathematics, University of Utah, 155 South 1400 East room 233, Salt Lake City, Utah, 84112, USA
Nicolae-Alexandru P. NICOROVICI – nicolae@physics.usyd.edu.au
School of Physics, University of Sydney, NSW, 2006, Australia