Broadband invisibility in the microwave range

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(PhysOrg.com) -- In the series *Star Trek*, Klingons and Romulans have spaceships outfitted with cloaking devices that hide their presence from sight, as well as from the sensors of their rivals' spaceships. Unlike current invisibility cloaks, which are mostly effective only over a narrow range, these fictional devices provide a broadband type of invisibility that so far has eluded modern scientists.

Now, though, a team at the Helsinki University of Technology in Finland has demonstrated broadband cloaking of cylindrical objects in the microwave regime. “This really is a helpful development,” Sergei Tretyakov tells *PhysOrg.com*. “Most other invisibility devices are very narrow in the range they affect.” Additionally, many invisibility cloaks are produced with the use of materials with extreme electromagnetic properties. “These are exotic materials that often have a great deal of loss and are dispersive,” Tretyakov continues.

Along with Pekka Alitalo, Olli Luukkonen and Constantin Simovski, Tretyakov believes that invisibility can be obtained over a broader range of frequencies without the need for electromagnetic mumbo-jumbo. Instead, the Helsinki team makes use of a simple metallic structure made from layers. The results of their experiment can be seen in *Physical Review Letters*: “Broadband electromagnetic cloaking of long cylindrical objects.”

“Even though we are cloaking an object from electromagnetic waves, we don’t need to use special materials with exotic electromagnetic properties

to create a cloak," Tretyakov says. "Instead, it is possible to cloak objects shaped like cylinders using simple structures made from conducting layers." These cloaking devices are also invisible.

The experiment blocking microwave frequencies was done using a waveguide. The cylinder was enclosed with conducting sheets orthogonal to the electric field vector. Tretyakov points out that this setup is ideal for antennas, since it can help weed out interference. "Radio astronomy can probably benefit greatly from this, as you can create support for an antenna, and block out interference. In fact, the cloaking device itself could be an antenna."

One of the advantages of this cloaking device is that it can conduct an electrical current, and offers low loss. Additionally, the fact that it is made from normal metal means that the setup tested in Helsinki would be simpler and less expensive to make than some of the electromagnetic cloaking devices currently being tested.

For the most part, this experiment shows a type of broadband invisibility that could be achieved in communications and frequencies dealing mainly with radio. However, Tretyakov and his colleagues also performed a simulation of their cloaking setup in the optical range. "We couldn't so far make an experiment in the optical range," he admits, "but our setup should be scalable. And our simulation shows that this should be possible to do with visible objects, not just hiding them in the microwave range."

"Right now we are looking for a little help to set up optical experiments," Tretykov says. "We want to make the experiment, and it should be possible. But it is a little more complex than using the microwaves, and requires a little more time and funding to set up. But technologically, we should be able to do it."

Perhaps that advanced broadband cloaking device is a little closer than we thought.

More Information: Tretyakov, et. al. “Broadband electromagnetic cloaking of long cylindrical objects,” Physical Review Letters (2009). Available online: link.aps.org/doi/10.1103/PhysRevLett.103.103905.