'Metascreen' forms ultra-thin invisibility cloak

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(Phys.org) —Up until now, the invisibility cloaks put forward by scientists have been fairly bulky contraptions – an obvious flaw for those interested in Harry Potter-style applications.

However, researchers from the US have now developed a cloak that is just micrometres thick and can hide three-dimensional objects from microwaves in their natural environment, in all directions and from all of the observers' positions.

Presenting their study today in the *New Journal of Physics*, the researchers, from the University of Texas at Austin, have used a new, ultrathin layer called a "metascreen".

The metascreen cloak was made by attaching strips of 66 μm-thick copper tape to a 100 μm-thick, flexible polycarbonate film in a fishnet design. It was used to cloak an 18 cm cylindrical rod from microwaves and showed optimal functionality when the microwaves were at a frequency of 3.6 GHz and over a moderately broad bandwidth.

The researchers also predict that due to the inherent conformability of the metascreen and the robustness of the proposed cloaking technique, oddly shaped and asymmetrical objects can be cloaked with the same principles.

Objects are detected when waves – whether they are sound, light, x-rays or microwaves – rebound off its surface. The reason we see objects is

because light rays bounce off their surface towards our eyes and our eyes are able to process the information.

Whilst previous cloaking studies have used metamaterials to divert, or bend, the incoming waves around an object, this new method, which the researchers dub "mantle cloaking", uses an ultrathin metallic metascreen to cancel out the waves as they are scattered off the cloaked object.

"When the scattered fields from the cloak and the object interfere, they cancel each other out and the overall effect is transparency and invisibility at all angles of observation," said co-author of the study Professor Andrea Alu.

"The advantages of the mantle cloaking over existing techniques are its conformability, ease of manufacturing and improved bandwidth. We have shown that you don't need a bulk metamaterial to cancel the scattering from an object – a simple patterned surface that is conformal to the object may be sufficient and, in many regards, even better than a bulk metamaterial."

Last year, the same group of researchers were the first to successfully cloak a 3D object in another paper published in *New Journal of Physics*, using a method called "plasmonic cloaking", which used more bulky materials to cancel out the scattering of waves.

Moving forward, one of the key challenges for the researchers will be to use "mantle cloaking" to hide an object from visible light.

"In principle this technique could also be used to cloak light," continued Professor Alu.

"In fact, metascreens are easier to realize at visible frequencies than bulk metamaterials and this concept could put us closer to a practical

realization. However, the size of the objects that can be efficiently cloaked with this method scales with the wavelength of operation, so when applied to optical frequencies we may be able to efficiently stop the scattering of micrometer-sized objects.

"Still, we have envisioned other exciting applications using the mantle cloak and visible light, such as realizing optical nanotags and nanoswitches, and noninvasive sensing devices, which may provide several benefits for biomedical and optical instrumentation."

More information: Demonstration of an ultra-low profile cloak for scattering suppression of a finite-length rod in free space, J C Soric et al 2013 *New J. Phys.* 15 033037, iopscience.iop.org/1367-2630/15/3/033037/article

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