Researchers create terahertz invisibility cloak

EurekAlert

Researchers at Northwestern University have created a new kind of cloaking material that can render objects invisible in the terahertz range.

Though this design can't translate into an invisibility cloak for the visible spectrum, it could have implications in diagnostics, security, and communication.

The cloak, designed by Cheng Sun, assistant professor of mechanical engineering at Northwestern's McCormick School of Engineering and Applied Science, uses microfabricated gradient-index materials to manipulate the reflection and refraction of light. Sun's results will be presented May 4 at CLEO: 2011, the annual Conference on Lasers and Electro-Optics.

Humans generally recognize objects through two features: their shape and color. To render an object invisible, one must be able to manipulate light so that it will neither scatter at an object's surface nor be absorbed or reflected by it (the process which gives objects color).

In order to manipulate light in the terahertz frequency, which lies between infrared and microwaves, Sun and his group developed metamaterials: materials that are designed at the atomic level. Sun's tiny, prism-shaped cloaking structure, less than 10 millimeters long, was created using a technique called electronic transfer microstereolithography, where researchers use a data projector to project an image on a liquid polymer, then use light to transform the liquid layer into a thin solid layer. Each of the prism's 220 layers has tiny holes that are much smaller than terahertz wavelengths, which means they can vary the refraction index of the light and render invisible anything located beneath a bump on the prism's bottom surface; the light then appears to be reflected by a flat surface.

Sun says the purpose of the cloak is not to hide items but to get a better understanding of how to design materials that can manipulate light propagation.

"This demonstrates that we have the freedom to design materials that can change the refraction index," Sun said. "By doing this we can manipulate light propagation much more effectively."

The terahertz range has been historically ignored because the frequency is too high for electronics. But many organic compounds have a resonant frequency at the terahertz level, which means they could potentially be identified using a terahertz scanner. Sun's research into terahertz optics could have implications in biomedical research (safer detection of certain kinds of cancers) and security (using terahertz scanners at airports).

Next Sun hopes to use what he's learned through the cloak to create its opposite: a

terahertz lens. He has no immediate plans to extend his invisibility cloak to visible frequencies.

"That is still far away," he said. "We're focusing on one frequency range, and such a cloak would have to work across the entire spectrum."

SOURCE [1]

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