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Scientists are seeking ultimate vanishing act

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WASHINGTON -- Researchers at several major American universities are working on an idea so revolutionary, it has to be not seen to be believed.

Teams at Duke, Purdue and Wake Forest are carrying on parallel research toward the elusive goal of invisibility. And while they agree an invisibility cloak is still a ways off, recent breakthroughs offer hope for developing the ultimate camouflage.

"Theoretically it's possible," said David Smith, a professor in Duke University's department of electrical and computer engineering. "As other technologies develop, we might see more practical paths."

It was groundbreaking work unveiled last year by Smith and others at Duke that got people talking more seriously about Harry Potter's cloak or the devices that conceal Klingon and Romulan war vessels in the "Star Trek" universe.

Since that breakthrough, research has accelerated to the point where scientists now believe they can make single colors in the spectrum of visible light disappear. While this is a small step toward controlling the entire spectrum, scientists are hailing it as an exciting start.

Sight is all about light waves -- more specifically, the portion of the electromagnetic spectrum that is visible to the human eye when emitted or reflected by an object. Prevent an object from reflecting or emitting visible light, and humans can't see it.

A simple way of looking at the Duke breakthrough, Smith said, is that these visible light waves would flow around the cloak rather than being reflected. Picture, he says, water flowing around a stone in a river.

To do this, Smith and other researchers are developing "metamaterials" that can manipulate waves in ways unlike any naturally occurring materials. The Duke device is a series of concentric circles made of fiberglass with tiny copper lines that successfully cloaked a very small frequency range in the microwave portion of the electromagnetic spectrum.

Smith hopes eventually to come up with a way in which "all light or other electromagnetic waves are swept around the area, guided by the metamaterial to emerge on the other side as if they had passed through an empty volume of space."

NEW-FANGLED HAIRBRUSH

The electromagnetic spectrum includes radio waves, microwaves, infrared radiation and X-rays as well as the small range of light waves that is visible to humans. It is these visible light waves that would have to be manipulated to achieve the goal of invisibility.

This is where researchers at Purdue have been following up on the work at Duke and at Imperial College London, where some early theoretical research behind the current advances took place. The Purdue

researchers have designed, but not yet built, a cylinder with an array of tiny needles radiating outward like bristles on a hairbrush to manipulate visible light.

"The design ... would bend light around the object being cloaked. Background objects would be visible, but not the object surrounded by the cylindrical array of nano-needles," said Vladimir Shalaev, a professor of electrical and computer engineering at Purdue.

While the Duke work successfully cloaked a small portion of the microwave spectrum, the Purdue scientists believe their design will cloak, for the first time, a part of the visible spectrum.

For now, its cloaking ability would be limited to a single color from the visible light range of the spectrum. "But this is a first design step toward creating an optical cloaking device that might work for all wavelengths of visible light," Shalaev said.

"How to create a design that works for all colors of visible light at the same time will be a big technical challenge, but we believe it's possible. It is clearly doable. In principle, this cloak could be arbitrarily large, as large as a person or an aircraft."

USEFUL BYPRODUCTS

Dave Carroll, director of the center for nanotechnology and molecular materials at Wake Forest University, is a little less optimistic that true invisibility can be attained.

But even if it can't, he said, the research may yield other useful technologies, like the development of materials that can be used in other forms of camouflage, light manipulation and communications.

Other camouflaging technologies also show promise in being able to better conceal objects and people, Carroll noted. One technique involves collecting images of the space behind an object and projecting those images onto the front of the object.

Devices using this technology, including some items of clothing, already have been made, but they have significant limitations. They don't work, for example, if an observer is looking at a cloaked object from an angle.

"Cloaking and camouflage are just illusions -- the object is still there. It's not gone, it just gives the appearance that it's not there," Carroll said.

Should scientists eventually succeed, the applications would seem limitless, beginning with the military. Imagine an invading force of soldiers, vehicles and aircraft that are completely invisible to the enemy. Spies or undercover cops, meanwhile, could sit in discreetly on clandestine meetings.

Or, as in the case of the title character in H.G. Wells' "The Invisible Man," such technology could be used to terrorize the public with robbery sprees and violence should it fall into the wrong hands.

"We certainly wouldn't want that," Carroll said.

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