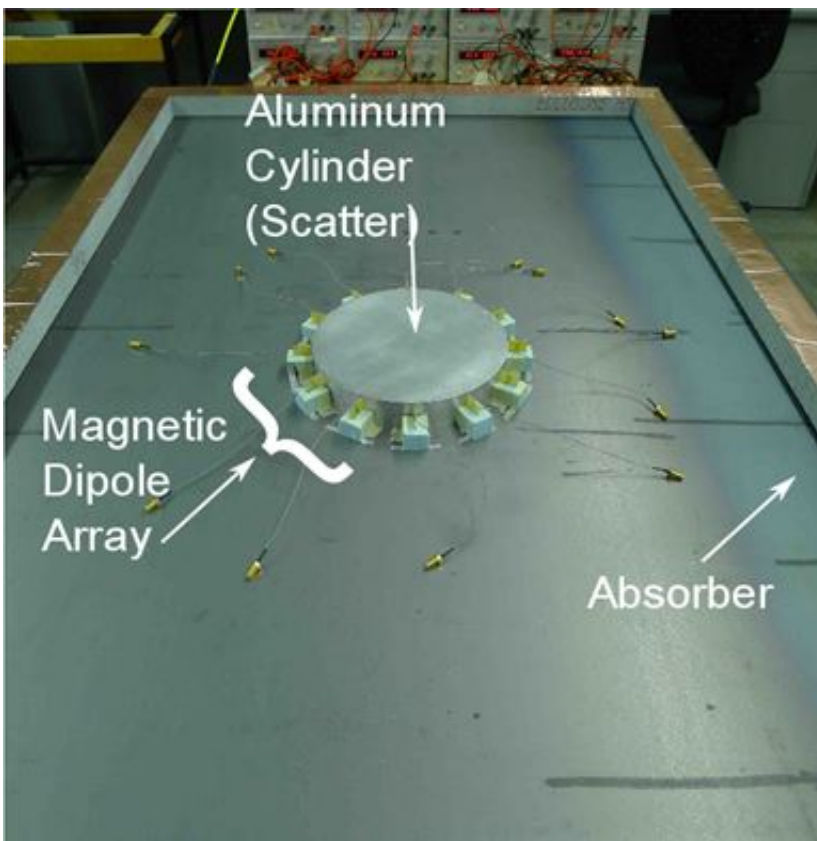


# Thin, active invisibility cloak demonstrated for first time

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This is the set up of the lab where U of T Professor George Eleftheriades and PhD student Michael Selvanayagam have designed and tested a new approach to cloaking -- by surrounding an object with small antennas that collectively radiate an electromagnetic field. The radiated field cancels out any waves scattering off the cloaked object. Credit: University of Toronto

(Phys.org) —Invisibility cloaking is no longer the stuff of science fiction: two researchers in The Edward S. Rogers Sr. Department of Electrical & Computer Engineering have demonstrated an effective invisibility cloak that is thin, scalable and adaptive to different types and sizes of objects.

Professor George Eleftheriades and PhD student Michael Selvanayagam have designed and tested a new approach to cloaking—by surrounding an object with small antennas that collectively radiate an [electromagnetic field](#). The radiated field cancels out any waves scattering off the cloaked object. Their paper 'Experimental demonstration of active electromagnetic cloaking' appears today in the journal *Physical Review X*.

"We've taken an electrical engineering approach, but that's what we are excited about," says Eleftheriades. "It's very practical."

Picture a mailbox sitting on the street. When light hits the mailbox and bounces back into your eyes, you see the mailbox. When radio waves hit the mailbox and bounce back to your radar detector, you detect the mailbox. Eleftheriades and Selvanayagam's system wraps the mailbox in a layer of tiny antennas that radiate a field away from the box, cancelling out any waves that would bounce back. In this way, the mailbox becomes undetectable to radar.

"We've demonstrated a different way of doing it," says Eleftheriades. "It's very simple: instead of surrounding what you're trying to cloak with a thick metamaterial shell, we surround it with one layer of tiny antennas, and this layer radiates back a field that cancels the reflections from the object."

Their experimental demonstration effectively cloaked a metal cylinder from radio waves using one layer of loop antennas. The system can be

scaled up to cloak larger objects using more loops, and Eleftheriades says the loops could become printed and flat, like a blanket or skin. Currently the antenna loops must be manually attuned to the electromagnetic frequency they need to cancel, but in future they could function both as sensors and active antennas, adjusting to different waves in real time, much like the technology behind noise-cancelling headphones.

Work on developing a functional [invisibility cloak](#) began around 2006, but early systems were necessarily large and clunky—if you wanted to cloak a car, for example, in practice you would have to completely envelop the vehicle in many layers of metamaterials in order to effectively "shield" it from electromagnetic radiation. The sheer size and inflexibility of the approach makes it impractical for real-world uses. Earlier attempts to make thin cloaks were not adaptive and active, and could work only for specific small objects.

Beyond obvious applications, such as hiding military vehicles or conducting surveillance operations, this cloaking technology could eliminate obstacles—for example, structures interrupting signals from cellular base stations could be cloaked to allow signals to pass by freely. The system can also alter the signature of a cloaked object, making it appear bigger, smaller, or even shifting it in space. And though their tests showed the cloaking system works with [radio waves](#), re-tuning it to work with Terahertz (T-rays) or light waves could use the same principle as the necessary antenna technology matures.

"There are more applications for radio than for light," says Eleftheriades. "It's just a matter of technology—you can use the same principle for light, and the corresponding antenna technology is a very hot area of research."

Provided by University of Toronto

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