Close Window

Technology Review
PUBLISHED BY MIT
Friday, June 08, 2007

A Wirelessly Powered Lightbulb

Researchers at MIT have created a revolutionary device that could remotely charge batteries and power household appliances.

By Kate Greene

Researchers at MIT have shown that it's possible to wirelessly power a 60-watt lightbulb sitting about two meters away from a power source. Using a remarkably simple setup--basically consisting of two metal coils--they have demonstrated, for the first time, that it is feasible to efficiently send that much power over such a distance. The experiment paves the way for wirelessly charging batteries in laptops, mobile phones, and music players, as well as cutting the electric cords on household appliances, says Marin Soljačić, professor of physics at MIT, who led the team with physics professor John Joannopoulos.

The research, published in the June 7 edition of *Science Express* (the online publication of *Science* magazine), is the experimental demonstration of a theory outlined last November by the MIT team. (See "Charging Batteries without Wires.") "We had strong confidence in the theory," says Soljačić. "And experiment indeed confirmed that this worked as predicted."

The setup is straightforward, explains Andre Kurs, an MIT graduate student and the lead author of the paper. Two copper helices, with diameters of 60 centimeters, are separated from each other by a distance of about two meters. One is connected to a power source--effectively plugged into a wall--and the other is connected to a lightbulb waiting to be turned on. When the power from the wall is turned on, electricity from the first metal coil creates a magnetic field around that coil. The coil attached to the lightbulb picks up the magnetic field, which in turn creates a current within the second coil, turning on the bulb.

This type of energy transfer is similar to a well-known phenomenon called magnetic inductive coupling, used in power transformers. However, the MIT scheme is somewhat different because it's based on something called resonant coupling. Transformer coils can only transfer power when they are centimeters apart--any farther, and the magnetic fields don't affect each other in the same way. In order for the MIT researchers to achieve the range of two meters, explains Soljačić, they used coils that resonate at a frequency of 10 megahertz. When the electrical current flows through the first coil, it produces a 10-megahertz magnetic field; since the second coil resonates at this same frequency, it's able to pick up on the field, even from relatively far away. If the second coil resonated at a different frequency, the energy from the first coil would have been ignored.

The researchers' approach, says Soljačić, also makes the energy transfer efficient. If they were to emit power from an antenna in the same way that information is wirelessly transmitted, most of the power would be wasted as it radiates away in all directions.

Indeed, with the method used to transfer information, it would be difficult to send enough energy to be useful for powering gadgets. In contrast, the researchers use what's known as nonradiative energy that is bound up near the coils. In this first demonstration, they showed that the scheme can transfer power with an efficiency of 45 percent.

Wireless power transfer is an idea that's more than 100 years old. In the 1890s, physicist and electrical engineer Nikola Tesla proposed beaming electricity through the air. However, soon thereafter, power cables became the commonly accepted means of transporting electricity across distances. But with the widespread adoption of small, portable devices with batteries in need of constant recharging, people's attention is again turning to wireless power. In fact, the startup Powercast, based in Ligonier, PA, has, using a different approach from that of the MIT team, developed a wireless power system that can transmit low wattages across a distance of about a meter. To start, the company is targeting devices with low power consumption, such as sensors, but it's hoping to ramp up to more power-hungry gadgets in the future.

One concern that people might have, says Sir John Pendry, professor of physics at Imperial College in London, is health effects. "There will be safety issues, real or imagined," he says. "After all, the power has to pass through space in some form or other, and pass through any bodies lying in its path. The [MIT] team has minimized this problem by making sure that the power is mainly in the form of a magnetic field, a form of energy to which the body is almost entirely insensitive."

Based on calculations, Soljačić believes that the scheme is safe, even for people with implanted medical devices, such as pacemakers. Although the researchers have not made a detailed study to test how the system interferes with pacemakers, Soljačić says that they don't expect it to interact strongly with objects that don't resonate at the same frequencies used to transfer power.

At this point, the team has applied for a number of patents and is planning to commercialize the technology, although the researchers expect that it could take a few years before devices with such wireless power systems will make it to consumers. In the meantime, the team is exploring different materials and alternate coil geometries to try to extend the range and ramp up the power.