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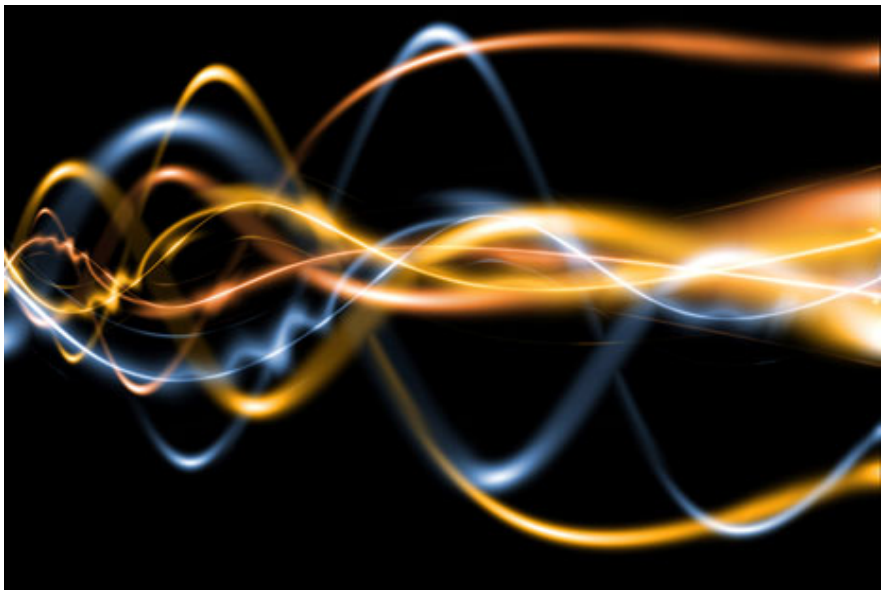
NEWS

Acoustic Energy Harvesters Gaining Volume

So far, harvesters can get milliwatts of electricity from sound. That might be enough for some things

By LUCAS LAURSEN / APRIL 2011



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26 April 2011—Where some people hear noise, Jeong Ho You hears energy. "Acoustic energy is everywhere," he says. And with the help of a tiny resonating chamber, he wants to trap some of that energy and convert it into a low-amperage current for use in small electronic devices. You, a mechanical engineer at Southern Methodist University, in Dallas, will be presenting the results of a computer simulation of a resonating chamber design at next month's Acoustical Society of America meeting in Seattle. He then plans to build a device to see how his idea holds up in the lab.

The siren song of acoustic energy is soft—so soft that some researchers don't think it's worth the trouble to harvest it. Mark Sheplak, a mechanical engineer at the University of Florida, in Gainesville, who helped build an acoustic energy harvester for use in a NASA jet engine research project, says, "A lot of people wrote it off because there are just a few applications where there's enough sound to be useful." The problem is that acoustic energy is not very dense: The sound of a crowd in full roar at London's Wembley Stadium would provide only enough energy to fry an egg, Sheplak estimates.

That may be true, but a growing number of useful electronic devices consume much less wattage than the average frying pan, which might need around 30 watts to fry an egg in 5 minutes. Watch batteries, RFID tags, and hearing aids draw 1 milliwatt or less, while some Bluetooth transmitters and laser pointers demand a bit more, according to a 2008 review of acoustic energy harvesting (PDF, 4KB) by Stewart Sherrit of the Jet Propulsion Laboratory, in Pasadena, Calif.

You says his ambitions are small: "We can't replace a whole cellphone battery, but maybe we could extend battery life." But some experts say even that goal might be ambitious. You wouldn't reveal his exact wattage goal, but for a phone battery, the device would probably have to do an order of magnitude better than previous technology.

Sheplak's team managed to extract about 30 mW in a laboratory experiment by mimicking a jet engine. They used a Helmholtz resonator—a cylinder that lets noise in through a hole at one end. At the other end, a small piezoelectric plate vibrates and generates electric current. The effect is the same as blowing on the mouth of a glass bottle: The tone and the volume depend on the shape of the bottle.

The device Sheplak and his colleagues designed powered an experimental muffler, which they could adjust to dampen the signature sounds of each stage of a jet engine's operation, such as takeoff, cruise, and landing. Existing mufflers are static and work best at just one frequency, and therefore during only one phase of flight.

Mike Jones, the NASA official who oversaw Sheplak's project, says that such a design would enable engine manufacturers to install mufflerlike "active liners" in their engines without the hassles of electrical wiring. Jones adds that to take the technology commercial, the team would need to generate more power—enough to control multiple liner

cells—and integrate sensors to detect the engine's sound profile. Then they'd need to test their system in a flow duct and eventually in a real engine. Other applications might include self-powered noise-level monitors for factories, suggests Sheplak, but "there's still a physical limitation since the energy intensity levels are so low."

"My idea is kind of different," You says. "I'm using...a piezoelectric beam along the length of the cavity so that I can capture more energy."

Such innovations will be necessary to get useful amounts of energy from sound, says Shashank Priya, a mechanical engineer who works at the Center for Energy Harvesting Materials and Systems at Virginia Tech, in Blacksburg. In particular, he says, piezoelectric materials need to be tailored for energy harvesting rather than their other roles, such as for ultrasound imaging. His laboratory has done so by adding texture to the materials, which doubles or triples their performance.

About the Author

Lucas Laursen is a freelance journalist based in Zurich. In the September 2010 issue of *IEEE Spectrum*, he wrote about a computer system that warns farmers when laying hens are going to start murderous rampages.