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Fly lends an ear to microphone design

By Peter Weiss

In the past decade, biologists discovered a new mechanism by which animals locate sounds. The finding emerged from the observation that a parasitic fly stalks crickets by sound, even though the fly's head is too small for any of the previously known sound-localization mechanisms to work. Now, engineers are creating a micro-microphone inspired by the fly's extraordinary ear.

"The fly has given us an entirely different way of looking at microphone design," says Ronald N. Miles of the State University of New York at Binghamton.

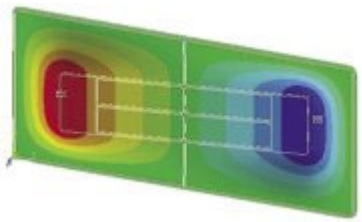
Sounds make this heart-shaped fly ear teeter-totter and flap.
R. Hoy/Cornell Univ.

For one thing, the new design strategy could lead to hearing aids that hide within a person's ear canal yet gather sound primarily from the direction the listener is facing, its developers say. It may also find use in battlefield-surveillance devices and yet more compact substitutes for microphones now used in cell phones and other communications gear.

Last year, a Canadian study showed that female flies of the species *Ormia ochracea* pinpoint sounds to within 2 compass degrees—as precisely as an owl does (SN: 11/11/00, p. 308). Owls, however, have large heads and ear-to-ear spacings big enough to exploit time delays and other indicators of a sound's direction, says Ronald R. Hoy of Cornell University, codiscoverer of the fly's unusual hearing apparatus.

The side-by-side eardrums of the fly span only about a millimeter. Unlike any other known ear structure, there's a bridge of stiff material connecting the two membranes almost as a hinge might, Hoy notes. Other small-headed animals, including birds and frogs, use an internal air tube between ears to discern direction information, he adds.

Vibration studies by Miles, Hoy, and their colleagues have revealed that, because of its bridge, the fly ear responds to sound with mixtures of two motions: rocking like a teeter-totter and flapping like a wing. What's more, the location in the fly's ear structure of the peak amplitude from the vibrations reveals the direction of the sound source.



Colored simulation depicts fly-inspired diaphragm for microphones as it teeters up to the left.
R. Miles/SUNY Binghamton

Using techniques for making microchips, the researchers have made a 1-mm-by-2-mm silicon diaphragm with a mechanical structure that resembles the fly ear's. While the device still lacks electrical pickups, it mimics the fly ear's motions, Miles says. He described the new device on Dec. 4 at the annual meeting of Acoustical Society of America in Fort

Lauderdale, Fla.

The fly-inspired design "is breaking new ground in the area of acoustic sensing," says Edgar J. Martinez of the Defense Advanced Research Projects Agency in Arlington, Va., which helps fund the work.

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Further Readings:

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