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January 03, 2004

Microphone emulating fly's ear may be aid to human hearing

From: Chicago Tribune
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By Anne Eisenberg New York
Times News Service

Carrying on a conversation in a busy restaurant can be a challenge for anyone who wears a hearing aid. The devices amplify speech, but they amplify the general racket in the room, too.

But a microphone that imitates the remarkably acute hearing of a tiny fly--and gives it a boost with the latest in miniature lasers and signal processing--may one day help solve this problem.

Ronald Miles, a professor of mechanical engineering at the State University of New York at Binghamton, has received a \$6.5 million grant from the National Institutes of Health to develop sensing and processing technology for a small, highly sensitive silicon microphone that

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could be the basis of powerful hearing aids of the future.

The microphone is designed to pick up what a companion across the table is saying while ignoring ambient noise.

The microphone structure is based on the ears of the fly *Ormia ochracea*. The female of this species uses her fine hearing to pick out the sound of distant crickets, which serve as hosts on which she can deposit her larvae. The larvae burrow into the crickets, which are then eaten by the larvae as they mature.

Imitating the tympanal structures of the fly may lead to practical benefits.

"This particular fly has solved the problem of hearing and noise," said Lynn Luethke, a program director at the National Institute on Deafness and Other Communication Disorders, the section of the National Institutes of Health that is sponsoring the Binghamton work. "Dr. Miles is taking that biology and trying to apply it to the mike that would be a component in a hearing aid or, possibly, cochlear implants."

Many people might one day profit from this research. Some 28 million Americans suffer from hearing loss, Luethke said. "Only 20 percent of those people who might benefit from hearing aids currently even try them," she said, "and only half of that 20 percent are satisfied."

Miles' microphone could help change this statistic by preventing some unwanted noise from getting into the ear.

"Right now, lots of people that could use hearing aids don't, and for good reason--there's this sense of noise and some distortion of the sound," Luethke said. "Just turning up the volume usually doesn't help."

The *Ormia ochracea* deserves a lot of credit for the invention of the microphone, Miles said. The two membranes on the fly's hearing organ are close together and are mechanically coupled by a hingelike piece of tissue.

Miles imitated that hinged design in silicon. "In regular mikes, a membrane that vibrates is clamped all around, like a drumhead," he said. But in his microphone, the membrane works by rocking like a seesaw that is hinged on a central pivot.

"It looks like a teeter-totter, only really small," he said.

When acoustic waves come past, the sound pressure drives both sides of the teeter-totter. "If sound comes on both sides at exactly the same time and with the same amplitude," he said, the mechanism doesn't move. But if the sound comes to one side before the other, it moves because the two pressures are unequal.

The design ensures that the

diaphragm responds to sound from a specific direction. "What you want is a mike that rejects sound from behind or to the side, responding to sound only from the person talking," he said.

Miles has fit three of the rocking diaphragms onto a silicon chip about the size of a child's fingertip

Once the membranes are moving, the mechanical motion has to be converted to an electrical signal that can be amplified. Usually this is accomplished through changes in the electrical properties of the diaphragm.

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