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October 12, 2000

## Miles awarded \$3.15M project

*By Susan E. Barker*

Binghamton University Professor Ronald Miles has been awarded a \$3.15 million Defense Advance Research Projects Agency grant to develop for military purposes innovative sound processing technology inspired by the ears of a small fly.

His work will also find a host of important civilian applications, including next-generation hearing aids, security devices, cell phones and teleconferencing equipment, where the use of miniaturized directional microphones and signal processing can enhance performance significantly.

Chair of the University's mechanical engineering department, Miles said the three-year DARPA award can be expected to lead to the creation of such things as "smart dust" — microphones so small that they could be scattered across a battlefield to detect the sounds and determine the direction of troop or equipment movements, even providing enough sensitivity to alert infantry personnel to sniper activity.

"Bolt-action rifles are the weapon of choice for snipers," he said. "And often the first warning you might have of a sniper's presence would be hearing the engagement of the bolt. At that point, you'd better be able to figure out pretty quickly where the sound is coming from."

His project, which will involve partnerships with the University of Illinois at Urbana-Champaign, Boeing Phantom Works of Seattle and the Charles Stark Draper Laboratory Inc. of Cambridge, Mass, calls for tiny arrays of "ormiaphones," to be connected to a related signal-processing unit that will facilitate sound source localization and help users distinguish one type of sound from another. Work at the University of Illinois will focus on devising signal processing algorithms to reduce background noise, Draper will handle silicon fabrication, and Boeing will develop electronics packaging solutions and later help to demonstrate the effectiveness of the prototype.

"Ormiaphones" will be the world's smallest-ever directional microphones. They are so named by Miles for *Ormia ochracea*, the parasitoid fly that inspired his work. Using current technology, a unit to achieve the same end as Miles' proposed acoustic sensors would be at least the size of a breadbox. That's because, until now, man-made acoustic sensors have relied for the most part on technology inspired by the auditory systems of humans and other large mammals.

To locate the source of sounds, most mammals rely on a pair of isolated ears that provide input to a highly sophisticated central nervous system, where the differences in time of arrival to each ear and the differing level of the two signals are processed. A significant separation between the ears is necessary in this system, which is why most mammals, from humans to dogs, regularly cock their heads when attempting to locate the source of a sound. The movement is their behavioral attempt to exaggerate the distance between the ears so that the central nervous system can better weigh the difference in signals.

In small insects like *Ormia*, millions of years of evolution have given rise to innovative approaches to the problem of miniaturization. It was a cross-disciplinary study by Miles, Ronald Hoy of Cornell and Daniel Robert of the University of Zurich that determined the workings of a unique structure in the ear of *Ormia* and paved the way for Miles' latest project. That structure, the intertympanal bridge, allows the insect to locate, in pitch dark and with deadly accuracy, the crickets upon which it preys, even though its ears are located less than 100 microns apart.

Miles is also in the second year of a three-year \$1.1 National Institutes of Health grant to develop the world's smallest directional microphone for use in hearing aids.