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Michael Braukus
Headquarters, Washington
(Phone: 202/358-1979)

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John Bluck
Ames Research Center, Moffett Field, Calif.
(Phone: 650/604-5026)

RELEASE: 04-093**NASA Develops System To Computerize Silent, "Subvocal Speech"**

NASA scientists have begun to computerize human, silent reading using nerve signals in the throat that control speech.

In preliminary experiments, NASA scientists found that small, button-sized sensors, stuck under the chin and on either side of the "Adam's apple," could gather nerve signals, and send them to a processor and then to a computer program that translates them into words. Eventually, such "subvocal speech" systems could be used in spacesuits, in noisy places like airport towers to capture air-traffic controller commands, or even in traditional voice-recognition programs to increase accuracy, according to NASA scientists.

"What is analyzed is silent, or subauditory, speech, such as when a person silently reads or talks to himself," said Chuck Jorgensen, a scientist whose team is developing silent, subvocal speech recognition at NASA's Ames Research Center, Moffett Field, Calif. "Biological signals arise when reading or speaking to oneself with or without actual lip or facial movement," Jorgensen explained.

"A person using the subvocal system thinks of phrases and talks to himself so quietly, it cannot be heard, but the tongue and vocal chords do receive speech signals from the brain," Jorgensen said.

In their first experiment, scientists "trained" special software to recognize six words and 10 digits that the researchers repeated subvocally. Initial word recognition results were an average of 92 percent accurate. The first sub-vocal words the system "learned" were "stop," "go," "left," "right," "alpha" and "omega," and the digits "zero" through "nine." Silently speaking these words, scientists conducted simple searches on the Internet by using a number chart representing the alphabet to control a Web browser program.

"We took the alphabet and put it into a matrix -- like a calendar. We numbered the columns and rows, and we could identify each letter with a pair of single-digit numbers," Jorgensen said. "So we silently spelled out 'NASA' and then submitted it to a well-known Web search engine. We electronically numbered the Web pages that came up as search results. We used the numbers again to choose Web pages to examine. This proved we could browse the Web without touching a keyboard," Jorgensen explained.

Scientists are testing new, "noncontact" sensors that can read muscle signals even through a layer of clothing.

A second demonstration will be to control a mechanical device using a simple set of commands, according to Jorgensen. His team is planning tests with a simulated Mars rover. "We can have the model rover go left or right using silently 'spoken' words," Jorgensen said. People in noisy conditions could use the system when privacy is needed, such as during telephone conversations on buses or trains, according to scientists.

"An expanded muscle-control system could help injured astronauts control machines. If an astronaut is suffering from muscle weakness due to a long stint in microgravity, the astronaut could send signals to software that would assist with landings on Mars or the Earth, for example," Jorgensen explained. "A logical spin-off would be that handicapped persons could use this system for a lot of things."

To learn more about what is in the patterns of the nerve signals that control vocal chords, muscles and tongue position, Ames scientists are studying the complex nerve-signal patterns. "We use an amplifier to strengthen the electrical nerve signals. These are processed to remove noise, and then we process them to see useful parts of the signals to show one word from another," Jorgensen said.

After the signals are amplified, computer software "reads" the signals to recognize each word and sound. "The keys to this system are the sensors, the signal processing and the pattern recognition, and that's where the scientific meat of what we're doing resides," Jorgensen explained. "We will continue to expand the vocabulary with sets of English sounds, usable by a full speech-recognition computer program."

The Computing, Information and Communications Technology Program, part of NASA's Office of Exploration Systems, funds the subvocal word-recognition research. There is a patent pending for the new technology.

Publication-size images are available on the World Wide Web at:

<http://amesnews.arc.nasa.gov/releases/2004/subvocal/subvocal.html>

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