National Aeronautics and
Space Administration

Sensors

Silent Speech

Sub-audible speech recognition based on electromyographic signals

Human-to-human or human to machine communication occurs in many ways. Traditionally, visual and verbal processes dominate both the method and the presentation formats. As a result, technology to enhance human communication has focused on public, audible tasks such as those addressed by commercial speech recognition.
An alternative way of communicating developed at NASA Ames Research Center is based on the direct interpretation of nervous system control signals sent to speech muscles by the brain. We interpret non invasive aggregate surface measurements of ElectroMyographic Signals (EMGs) to categorize muscle activations prior to sound generation. Such signals arise when reading or speaking to oneself with or without actual lip or facial movements. Hence obtaining the speech information does not require visual observation, such as machine lip reading, to enhance recognition in high noise.

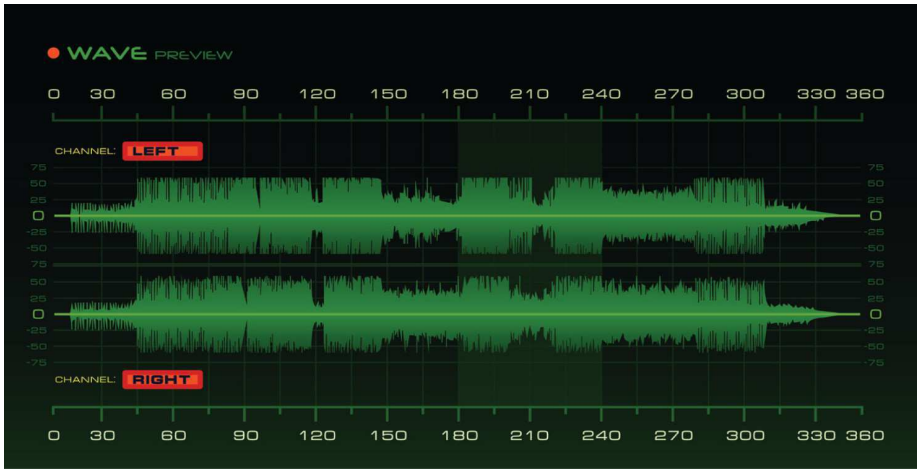
BENEFITS

- Minimal of word variations and non-invasive sensing
- Shared language and shared sound production
- Reliability and reasonable accuracy
- Resistance to presence of noise
- Soundless communication in difficult environments
- Mimic of an idealized thought-based approach
- Privacy

technology solution

THE TECHNOLOGY

Silent speech seeks to increase the options available to future habitat designers by creating the technical infrastructure for transportable, multi-equipment, human machine interfaces. Freeing future hardware designs of many of the constraints of human physical instrumentality will save payload weight, increase design robustness, and standardize interface training requirements of exploration system missions.
Our research is concerned with developing the full potential of electromyographic signal (EMG) interfaces to enhance NASA human exploration missions. We are approaching this goal through a series of increasingly sophisticated experiments, implementation prototypes, and wearable non-intrusive sensor developments. One of these sets of experiments deals with sub-vocal speech recognition. In this work, we are using surface signals from the larynx and sub-lingual areas of the neck and throat to recognize silently mouthed control words and to identify speakers biometrically based on living neural signal characteristics. Current implementations use EMG interfaces to control a simulated Mars rover in real-time and to perform a typical information gathering/web browsing task. We plan on extending the present simple speech recognition capabilities by extracting increasingly fine detail from EMG signals to determine their underlying vowel and consonant structure, move toward real-time continuous speech recognition, and explore an alternative method, direct speechvocoding, taken from the EMG signal to enable true human-to-human noise immune communication. We will also be extending simulated control to real control of arobotic vehicle and testing the performance of the method with alternative atmospheric breathing gas mixtures closer to space conditions.



An image of a voice recognition program screen

APPLICATIONS

The technology has several potential applications:

- Human-to-machine commands
- Military operations
- Physical and speech-disabled persons
- Underwater operations
- Medical and emergency service workers
- Interactive database searches
- Homeland security
- Robotic command/control

PUBLICATIONS

Patent No: 8,200,486; 7,574,357

Web Browser Control Using EMG Based Sub Vocal Speech Recognition, 2005, IEEE System Sciences, HICSS 05. Proceedings of the 38th Annual Hawaii International Conference

More Information

National Aeronautics and Space Administration

Technology Partnerships Office

Ames Research Center

MS 202A-3
Moffett Field, CA 94035
855.627.2249
ARC-TechTransfer@mail.nasa.gov

http://technology.nasa.gov/

www.nasa.gov

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