HEARING TECHNOLOGY

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Hearing Technology

The long-term goal of research in Hearing Technology is to understand

- how the physiological state of the human auditory system affects the ability to detect and analyse sound,
- how an impaired ability to detect and analyse sound affects the ability to understand and produce speech,
- how personal aids should be designed and individually fitted to compensate for hearing impairment.

The group pursues several applied projects concerning the design, fitting, and evaluation of personal aids for the hearing impaired, as well as methods and systems for teaching and training of speech perception and speech production.

Highlights 2000

Three major milestones were reached during the year 2000:

1. A handbook was published, covering the theoretical basis and practical recommendations for clinical hearing-aid fitting in Sweden. Members of our group co-ordinated the writing and edited the final version of the book. It is now used as course literature for Audiology programs at universities in Sweden and Norway.
2. A series of studies on hearing-aid fitting methods were summarised in a Sc.Lic. Thesis. The results raise some serious questions regarding the acceptability of several methods that are widely used internationally.
3. A three-year study on the benefit of a spectral-subtraction noise suppression

systems for hearing aids was successfully concluded. The results showed substantial benefits in terms of listening comfort, but only marginal improvements in speech intelligibility.

Signal processing algorithms for hearing instruments

Advanced hearing instruments must adapt their characteristics automatically to varying acoustic listening conditions. A new algorithm for this purpose has been developed and evaluated in an industry-related project. The algorithm is based on hidden Markov models. The method is robust, as it uses only modulation properties of the signal and requires no information about absolute signal levels or spectral densities. It has been shown to distinguish reliably between sound environments consisting of speech in various types of background noise, within a wide range of signal-to-noise ratios.

Individual fitting of advanced hearing instruments

Several methods for computer-aided fitting of advanced (digital) hearing aids have been studied. The results led to a need for further study on the psycho-acoustical assumptions underlying most of these methods. This work is now pursued in a joint effort with the National Acoustic Laboratories in Sydney.

A special method for hearing-aid fitting, based on individual tests of masked short-tone thresholds, has been developed and tested at the hearing clinic at the Karolinska hospital in Stockholm. We have co-operated with this work in order to evaluate some of the effects of basic auditory-signal analysis on speech recognition.

Multi-modal sensory aids

Together with researchers in the speech group we are investigating a new method to support audio-visual telephone communication for hearing-impaired persons without special equipment for transmitting video information. The aim of this work is to generate an artificial talking face, which can be used as a lip-reading support by the hearing-impaired telephone user. The articulation movements of the artificial face are controlled by parameters automatically derived from the speech signal. Tests with hearing-impaired listeners have demonstrated that the artificial face can improve the intelligibility of telephone speech, even when the artificial face is controlled by an imperfect recognition system. Current work is aiming at setting up laptops with the software in order to pursue field trials. In parallel attempts to increase the benefit even further by improving the recognition system will also be made.

Evaluation of cochlear implants

The work on comparing results from conventional hearing aids and cochlear implants has been continued. The test battery includes measurement of time resolution, auditory, visual and audiovisual perception of consonants, vowels, prosodic features and speech tracking, as well as subjective assessment. The aim of the study is to obtain data to support criteria for patient selection for cochlear implant operations, and also to evaluate the relative importance of various speech cues for speech-reading support.

Teaching and training systems

We participate in an EU project (SPECO), developing a new audio-visual pronunciation teaching and training method and software system for speech- and hearing-impaired children. The basic part is a general language-independent measuring system and database editor. The database editor makes it possible to construct modules for all participant languages; these are English, Swedish, Slovenian and Hungarian. Two Support Systems have been developed, one of them being for teaching and training vowels and the other for fricatives and affricates.