

21. Speech Communication

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The aim of our research in speech communication is to develop models for the production and perception of words in sentences and to apply this knowledge to problems of communicating with machines by speech and to the study of communicative disorders and speech development in children.

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We have carried out a number of studies of the production and perception of different classes of speech sounds, with a view towards understanding the acoustical and perceptual basis of the distinctive features and the influences of context on the acoustic manifestations of these features. For example, we are examining the spectral characteristics of vowels that most influence their perceived phonetic quality, the influence of word boundaries on the acoustic characteristics of consonant sequences, the acoustic correlates of nasalization of vowels (both in English in the context of nasal consonants and in languages that have a nasal-nonasal distinction for vowels), the characteristics of [l] and [r] and their influence on adjacent vowels, the burst characteristics for certain voiced and voiceless stop consonants, and the properties of the glottal source as they are influenced by breathiness and other laryngeal adjustments.

Our ongoing research on various aspects of machine recognition and synthesis of speech includes

1. Projects on word recognition from stored templates and from phonetically based properties
2. A study of the structure of the sequence of phonetic elements in a large lexicon and the implications of these constraints for the development of a phonetically based word recognition system
3. Methods for synthesis by rule of a female voice
4. Methods of low bit-rate speech transmission based on back-to-back speech recognition and synthesis.

We continue to gain insight into the speech planning process through the analysis of speech errors, both in normal speech and in specially-designed "tongue-twisters." Our work on the speech production process includes studies of jaw movements and detailed examination of the precision with which various articulatory structures need to be controlled in the production of different classes of vowels.

Our research on mechanisms of auditory processing of speech over the past year has included a study of the intelligibility of speech processed by a vocoder with critical-band spectral representation, development of a model for perceptual interpretation of durational cues in English sentences, and completion of a collaborative study (with Eaton Peabody Laboratory of the Massachusetts Eye and Ear Infirmary) of the response of single units in the auditory nerve to sounds with speechlike characteristics.

Part of our effort has also been devoted to the development of computer-based facilities for speech research. This includes a physiological signal processing facility and an interactive environment for the study of the acoustic properties of speech sounds.