Design Fundamentals for a Tactile Speech Processor:

i) Encoding of Speech Information, and
ii) Biomedical Safety Considerations.

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Approaches to providing speech information through the tactual modality have varied in: number and spatial location of transducers; method of interfacing with the skin's sensory apparatus; and content of speech information presented. Use of a multiple speech feature encoding approach to design of a tactile device was implemented in the wearable multichannel electrotactile speech processor or Tickle Talker developed at the University of Melbourne. Psychophysical studies established that subjects could discriminate salient electrical parameters in the tactual display, and that this information could be used to discriminate acoustic speech feature contrasts. Results with normally-hearing and hearing-impaired adults and children using an F0F2 encoding strategy showed improved discrimination scores for closed-set speech feature discrimination batteries, closed-set vowel and consonant identification tasks, as well as for open-set word and sentence comprehension. Based on analyses of tactual encoding of speech features, alternative speech processing strategies designed to increase the quality of speech information available were evaluated. Results for two hearing-impaired adults showed improved feature discrimination with the addition of a voicing signal to the F0F2 strategy.

Biomedical safety investigations conducted concurrently have established that the electrical parameters of the stimulus waveform, electrode handset design, and electrical circuitry of the device are free from potential risks. Longer-term physiological assessments included measures of possible effects of electrical stimulation on tactual sensitivity, finger temperature, finger and hand blood flow, electrical thresholds and maximum comfortable levels, and on central nervous system function as measured by EEG. Results of the kinesthetic, vascular and neurological assessments showed no significant contraindications which might limit application or long-term use of the device.

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