

GENERATING VOCAL TRACT SHAPES IN CONTINUOUS SPEECH

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We will present a film which shows the generation of vocal tract shapes from acoustic data in continuous speech. The display we are trying to generate is roughly equivalent to a traditional midsagittal view of the vocal tract. The shape of the vocal tract is considered to be dependent on seven parameters, each of which may be predicted from acoustic data.

The position of the body of the tongue is defined in terms of two parameters: the amount of raising/lowering of the front part of the tongue, and the amount of raising/lowering of the back part of the tongue (Harshman et al. 1977). These two components can be combined to produce the tongue positions of all vowels and consonants that depend on the position of the body of the tongue.

The position of the tip of the tongue is specified by a third parameter. The jaw and lower teeth are controlled by a fourth parameter. Two further parameters are required to specify the height and width of the lip opening. The position of the velum constitutes a seventh parameter. The values of these physiological parameters are predicted from formant frequencies by a set of equations.

In order to assess the viability of this system, recordings were made of three subjects saying a number of simple phrases. The first three formant frequencies were determined at 10 msec intervals using a computerized LPC formant extraction system and spectrograms.

Given appropriate formant frequencies, plausible sequences of movements of the vocal organs were generated. Since the same set of formant frequencies can correspond to different vocal tract shapes, no claim can be made that these particular movements were used by these particular speakers. But, throughout most of the utterances, vocal tract shapes were generated that could have produced the observed formant frequencies.

Reference

Harshman, R., P. Ladefoged, and L. Goldstein (1977): "Factor analysis of tongue shapes", JASA 62, 693-707.