Fourier parameterization of the area function: evidence from speech production.
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The dominant parameterization of the area function used in the field of acoustic-articulatory relations characterizes the area function in terms of the location and degree of constriction (Stevens and House 1955 and Fant 1960). A different parameterization was presented by Schroeder (1967) and Mermelstein (1967). In this quantification, the area function is quantified in terms of its weights on a cosine series. Reasonable vocalic spectra can be generated using either parameterization. The main difference comes when we consider the inverse problem. The location and degree of constriction are related in a nonlinear fashion to the acoustic parameters, but Schroeder (1967) showed that the relation between formants and cosine coefficients of the area function is quite simple: in the first order approximation, each formant is related in a simple way to the weight on a single odd cosine, where symmetry is considered with respect to the middle of the tract. The even components of the area function do not contribute to the formants, so all area functions differing by an even component are isospectral. Mermelstein (1967) provided evidence that formant frequencies are predicted well even if even components are not included. In this paper, this claim is re-examined by using ultrasound data from natural speech. It will be shown that tongue shapes are well approximated by their odd components. It will then be argued that the Fourier decomposition of the area function is a better parameterization due to better approximation of speech production as well as simplifying the inverse problem [Work supported by NIH grant DC-02717].