ACOUSTICS2008/1517
MRI-based 3-D vocal tract acoustic analysis of an American English lateral sound

Xinhui Zhou[a], Carol Espy-Wilson[a], Mark Tiede[b] and Suzanne Boyce[c]

[a]Speech communication lab, Institute of systems research and department of electrical and computer engineering, University of Maryland, College Park, MD 20742, USA

[b]Haskins lab, 300 George street suite 900, New Haven, CT 06511, USA

[c]Department of communication sciences and disorders, University of Cincinnati, Mail location 0394, Cincinnati, OH 45267, USA

The lateral sound /l/ in American English involves a complex articulatory configuration that includes one or two lateral channels along the sides of the tongue, and sometimes a lingual-alveolar contact. The acoustic characteristics of /l/ consist of a third formant (F3) that is close in frequency to the F3 of the adjacent vowel(s), but is often considerably weaker in amplitude. Generally, there is relatively weak energy in the F3-F5 region. The articulatory-acoustic relationship is not well understood. Previous studies did not consider the 3-D vocal tract model and the area function extraction was based on some assumed model. In this study, we constructed a 3-D vocal tract geometry based on magnetic resonance images from one subject during sustained production of syllabic dark /l/ (as in "pole"), and performed finite-element analysis. The harmonic analysis showed that the frequency response of the 3-D vocal tract is comparable in many ways to the spectrum of the acoustic signal, suggesting good agreement between the actual and reconstructed vocal tracts. A pole-zero pair is found in F3-F4 region, which may explain the weak energy level in this frequency region. Application of the 3-D wave propagation property to vocal tract area function extraction will also be discussed. [Research supported by NIH.]