Study on an Acoustical Model of Speech Production Structure Including the Vibrations of the Velum and Vocal Tract Wall

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Janwu Dang

This thesis describes a study on an acoustical model of speech production structure including the vibrations of the velum and vocal tract wall. In order to construct a model of the velum, this study investigated velar motions by using separated sounds at several positions of phonatory organ in following cases. The sound radiations suggested that the nose cavity couples acoustically with the oral cavity even in the period of denasalized vowels. In this case, the velum was modeled as two plates connected with a dashpot and a spring. The investigation of stop consonants revealed that the velar stiffness varies, and the variation consists of a passive component and an active component. The passive one was formulated by intraoral pressure and nostril radiation. In the case of nasalized speech, the equivalent open area ratio of the velum was estimated by radiations from the lips and nostrils. According to these results, an acoustical model of the velum was developed for connected speech.

In order to take the vibration effect of the vocal tract wall into the model, this study estimated vocal tract wall impedance by two different methods. In method 1, the impedance was measured directly by intraoral sound pressure and cheek vibration. In method 2, the impedance was estimated by matching synthesized speech to real speech for the intraoral, pressure and radiations of buzz sound. The impedance values obtained from the two methods were consistent with each another for mass and stiffness per unit area. The mechanical resistance from the method 1 approached to that from the method 2 in the range of higher frequency.