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A study of the acoustical characteristics of vocal tracts with complicated shape

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Abstract

In order to clarify the relationships between vocal tract shape and speech spectrum, we have studied acoustical characteristics of complicated vocal tract shapes. Relationships between vocal tract shapes of normal people and acoustical characteristics have been studied. However, effects of complicated vocal tract shapes to acoustical characteristics are not clarified. Complicated shapes of vocal tracts such as articulatory disorders are caused speech distortion. In order to investigate the effects of vocal tract shapes to acoustical characteristics, this paper deal with articulatory disorders.

Measurement methods of vocal tract shapes and estimating methods of vocal tract transfer functions are important to investigate the acoustical characteristics of complicated vocal tracts. For estimating vocal tract transfer functions, accuracy of estimating methods is important. In this paper, the equivalent circuit model and the finite element method are evaluated. For normal people, these methods estimate vocal tract transfer functions accurately. On the other hand, for people who have articulatory disorders, the equivalent circuit model could not estimate. The finite element method estimates them effectively. Sound pressure and phase distributions of complicated vocal tract shapes show that sound wave propagation is sometimes not plane wave at less than 4,000 Hz. These results show that complicated vocal tract shapes affect to acoustical characteristics. These results also suggest causes of speech distortion by people which have articulatory disorders. Moreover, effects of palatal augmentation prosthesis and compensation movement of articulation to transfer functions are investigated by using deformed vocal tract models.

Key Words: Vocal tract transfer function, Vocal tract shape, Finite element method, MRI