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Acoustic characteristics of solid vocal tracts modeled from ATR MRI database of Japanese vowel production

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"ATR MRI database of Japanese vowel production" provides volumetric magnetic resonance images and speech data of the five Japanese vowels produced by a male native Japanese speaker. In this study, the database was used to evaluate acoustic characteristics of vocal tracts for five Japanese vowels; we measured frequency responses of realistic vocal tract solid models formed by a stereo-lithographic technique. The model's glottis was sealed with a plastic plane with a 1.2-mm hole. A time-stretched pulse signal generated from a horn driver unit was introduced into the solid model at the lip end. The response signals of the models were recorded at the model's glottis from the hole by a probe microphone. This method permits accurate measurement of acoustic characteristics of the vocal tract including the laryngeal cavity, which generates the laryngeal cavity resonance during closed-glottis periods of phonation [H. Takemoto et al., JASA, 120, 2228-2238 (2006), T. Kitamura et al., JASA, 120, 2239-2249 (2006)]. The results provide a benchmark for evaluating numerical analysis methods, such as transmission line models, finite element methods, and finite difference-time domain-methods, which have been used to study vocal tract acoustics. [Work supported by SCOPE (071705001) of Ministry of Internal Affairs and Communications, Japan.]