ACOUSTICS2008/2363
Evaluation of phonetic constraints in acoustic-to-articulatory inversion

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The objective is to evaluate phonetic constraints intended to guarantee the phonetic realism of vocal tract shapes generated by an articulatory model, i.e. here that of Maeda. The constraints are based on the relation between vocal tract shapes allowed for a vowel and formants frequencies of the vowel. They are speaker independent since they are derived from standard phonetic knowledge. We used them to reduce the number of solutions in acoustic-to-articulatory inversion. The impact of constraints has been investigated by comparing vocal tract shapes recovered by inverting five French vowels /i, e, a, u, y/ to those obtained by outlining articulator contours in X-ray images. To that purpose we used X-ray images (used by Maeda to elaborate his articulatory model) with the corresponding speech signal. The evaluation shows that unrealistic vocal tract shapes are penalized by constraints, that vocal tract shapes recovered through inversion are in very good agreement with X-ray images and that relevant articulatory variability is recovered when considering all vocal tract shapes corresponding to one vowel. These constraints thus complement the articulatory model very efficiently. Additionally, the inversion framework complemented by phonetic constraints is an efficient way of investigating the acoustic properties of an articulatory model.