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Muscle saturation effect in /i/ production: Counterevidence from a 3 D biomechanical model of the tongue

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Numerous works suppose the existence of a saturation effect to facilitate the control of the constriction area when producing vowel \i\. This study exploits a 3D biomechanical Finite Element model of the vocal tract to evaluate the effectiveness of this assumption. The model includes the tongue and its major muscles, represented as a hyperelastic body, inserted in the oral cavity including jaw, palate, pharyngeal walls and hyoid bone. Muscles activations are controlled with the lambda model (Equilibrium-Point Hypothesis). After determining a set of possible motor commands to generate vowel \i\, the impact of local variations of these commands on tongue shape was studied. The main tongue muscles motor commands were independently modified (by ,2%, 5%, 8% around their values at target) and the effect on the tongue shape and on the acoustic signal was studied. The simulations showed a global stabilization of the tongue body, thanks to the palatal contacts, but also variability in the alveolar groove due to the anterior genioglossus activation. Though extremely localized, this variation has an important impact on the constriction size and, then, on the acoustic signal. Consequently, a specific control of the articulatory variability could be necessary to explain experimental data for vowel \i\.

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