

Beyond the midsagittal plane: Multi-planar paced imaging, cross-plane imaging, and dynamic volumetric imaging of tongue motion in speech

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The research results from three investigations are summarized. In the first study, a method for the reconstruction of 3D tongue movement from multiple coronal ultrasound films with metronome-paced speech is presented. The method was loosely based on the approach by Yang & Stone (2002). Four normal speakers and one partial glossectomee recited a stanza from the poem “Daffodils”. An ultrasound transducer was positioned under the participant’s mandible and angled at four coronal planes using a lever system. The movement of the tongue surface in coronal planes was quantified, and a moving 3D surface was rendered. Quantitative data relating to aspects such as grooving, symmetry and correlations between different segments of the tongue are presented. The second study used a two-dimensional crystal matrix transducer (Philips X3-1) to simultaneously record a coronal and a midsagittal plane during a number of speech tasks. Data from two female speakers are presented and the biomechanical relationship between lingual protrusion and midsagittal grooving is discussed. In the third study, the X3-1 transducer was used to record six parallel coronal planes in two female speakers. The speakers recited a number of sentences with a controlled vowel and consonant content (anterior vs. posterior vowels, and alveolar vs. velar consonant content). The results are discussed with regards to Öhman’s theory of speech production.