

200-word abstract

A hierarchical task-based control model of speech incorporating sensory feedback

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We present a computational model of speech motor control that integrates vocal tract state prediction with sensory feedback. This model is hierarchical, incorporating both a high-level and low-level controller. The high-level controller orchestrates linguistically-relevant speech tasks, which are represented as desired constrictions along the vocal tract (e.g. close the lips). The output of the high-level controller is passed to a low-level controller that can issue motor commands at the level of the speech articulators in order to accomplish the desired constrictions. In order to generate these articulatory motor commands, this low-level articulatory controller relies on an estimate of the current state of the vocal tract. This estimate combines internal predictions about the consequences of issued motor commands with auditory and somatosensory feedback from the vocal tract. We show that our model is able to replicate important aspects of human speech behavior: it can produce stable speech behavior in the presence of noisy motor and sensory systems, it produces partial compensation to auditory perturbations, and it produces complete compensations to mechanical perturbations only when they interfere with current production goals.