Speech animation using electromagnetic articulography as motion capture data

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Overview
Electromagnetic articulography (EMA) captures the position and orientation of a number of markers, attached to the articulators, during speech. As such, it performs the same function for speech that conventional, marker-based motion capture does for full-body movements acquired with optical modalities.

We present an approach to processing EMA data from a motion-capture perspective and applying it to the visualization of an existing multimodal corpus of articulatory data, creating a kinematic 3D model of the articulators by adapting a conventional motion capture based animation paradigm.

Such an animated model can then be easily integrated into multimedia applications as an animation asset, allowing the visualization of speech production in an intuitive and accessible manner.

http://mngu0.org/

EMA data as motion capture

HIERARCHY
ROOT T3
OFFSET -0.0834774 -0.6861063 0.7226532
CHANNELS 6 XPosition YPosition ZPosition XRotation YRotation ZRotation
EndSite
OFFSET 0.0000000 0.0000000 0.0000000

ROOT upperlip
OFFSET -0.9456642 0.2978965 -0.1302958
CHANNELS 6 XPosition YPosition ZPosition XRotation YRotation ZRotation
EndSite
OFFSET 0.0000000 -1.0000000 0.0000000

MOTION
Frames: 724
Frame Time: 0.005

Fragment of one EMA sweep from mngu0 database in Biovision Hierarchy format. EMA coils are rendered over a 250 ms window (frame step = 3); lips, incisors at left, tongue coils 1 to 3 at right.

Articulatory model

The tongue is segmented from a volumetric magnetic resonance imaging (MRI) scan and retopologized into a mesh. The tongue mesh can be deformed using spline inverse kinematics (IK); the spline’s control points are modified by the EMA coils. Dental scans are registered into the same space and added to the rig.

Animation

For speech animation, the EMA data drives the animation rig. The ref and jaw coils control the maxilla and mandible, respectively; the tongue coils move the IK control points, which in turn deform the tongue mesh.