Internship proposal

Pointing movement by the tongue

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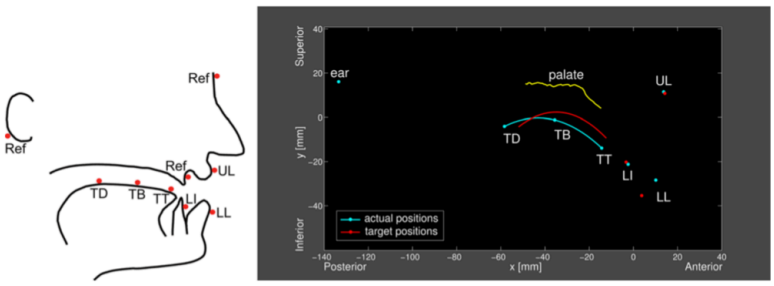
Background: The tongue plays a central role in basic biological functions: swallowing, respiration, and speaking. Control of the tongue is extremely robust and stable, enabling the achievement of those functions under various physical constraints, such as when walking, running, biking, lying on the bed or sitting (Perrier, 2012). Damage to the tongue function or its control severely degrades quality of life. Despite this importance, the control of the tongue is still ill-understood. Two specificities make its investigation more difficult: 1) the tongue is concealed inside the mouth, and 2) its movement originates from the deformation of a soft tissue (nonrigid body physics), contrary to the well-studied limb system in which the movement is produced by skeletal motion. The challenge of the internship is to experimentally study the mechanism of tongue motor control using a newly-developed technique, the real-time display of the tongue movement. We will focus on fast movements, typical of speech.

Purpose: The current project is **to study how the brain controls a fast visually-guided pointing movement of the tongue.** To evaluate the properties of this feedback control, we will use a "target jump paradigm", in which we sometimes introduce a perturbation by suddenly shifting the position of the target at movement onset. The technique was introduced for arm-reaching tasks (Goodale et al 1986, Day and Lyon, 2000) and is often used to probe human motor control. By comparing our findings to what is observed in arm-reaching studies, we hope to illuminate the mechanisms of the sensorimotor control of the tongue.

Method: The tongue position will be recorded by an electro-magnetometer (Northern Digital Wave), and the measured tongue position will be displayed on a monitor in real-time using MATLAB (See Figure 1 as example). In the test, we will measure the tongue trajectory to reach the visually-presented target. The movement data will be analyzed using signal processing in MATLAB. The statistical analysis will be done in R.



Outputs: The current internship is a challenging project to evaluate the performance of the brain in controlling fast movements of the tongue. Throughout this internship, the student will learn how biological movement can be measured from a human subject. In addition, the student will learn signal processing techniques for kinematic information using filtering, smoothing, peak extraction, outlier detection, and data regression. This is also an opportunity to learn how engineering techniques can be used to study human sensorimotor function and cognitive processes. This internship has developmental and preliminary aspects, but the obtained result would be novel and motivate future lines of research.

References:

Goodale, MA, Pelisson, D, Prablanc, C (1986). *Nature* 320, 748–750.
Day BL, Lyon IN (2000). *Exp Brain Res* 130:159–168.
Perrier P (2012). In: *Speech Planning and Dynamics* (Fuchs S, Weirich M, Pape D, Perrier P, eds), pp 191–283. Peter Lang.