

Internship proposal

Tongue stretch reflex

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Background: Stretch reflex is known as one mechanism that contributes to the stability of human sensorimotor control. When a muscle (or limb) is stretched by unknown disturbance, the muscle makes a quick contraction to maintain the posture (and then keep its length constant). This quick reflex has been mostly investigated in limb system, and the extent to which stretch reflex contributes to tongue motor control is still unknown. Although a previous study failed to induce a stretch reflex of the tongue (Neilson et al., 1979), we have found behaviorally that the tongue showed relatively quick reaction of motion in response to external mechanical perturbation (Ito et al., 2020). While this response has short latency similar to the one by reflex, it is still unclear whether it was actually driven by reflex mechanisms.

Purpose: The current project aims to **examine whether the tongue has a stretch-like reflex**. The study will try to induce a muscle stretch using a precisely-controlled robotic device, and will investigate the time response in electromyogram using signal-processing technique.

Method: Apart from a few studies (Ishiwata et al., 1997), it is very difficult to measure muscle activity without using invasive method for speech production task since the tongue muscles are located within several layers of tissues. One challenge of this internship is to develop a non-invasive method using surface electrodes to record electromyogram of the tongue muscles during speech production task and to develop analysis method for the electromyographic signal. The combination of the mechanical perturbation method using robotic device (Figure 1) and the electromyogram should clarify the role of tongue reflex, probably the stretch reflex, for the posture stabilization in speech production.

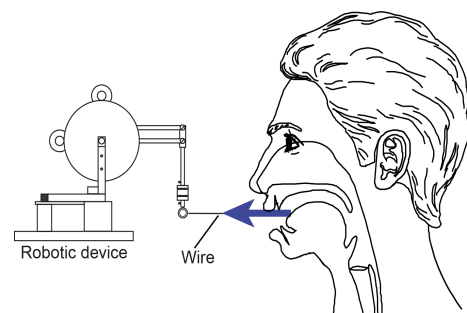


Figure 1: Experimental Setup

Outputs: The current internship is a challenging project to find a clue for stretch-like reflex in the tongue muscles, which has not been so far clearly evidenced. Throughout this internship, the student will learn how biological information can be measured from human subject, particularly electromyogram. In addition, the student will learn how to make psychophysiological test with sophisticated haptic-robotic device. The student will also learn the signal processing of biological information (electromyogram, kinematic data and acoustic signal) such as filtering, smoothing, peak extraction, outlier detection, data regression and further advanced method like linear predictive coding for acoustic signals. The result of this internship has been expected to illuminate novel function of tongue motor control that can be useful for clinical treatment, diagnosis and rehabilitation.

Reference:

- Ishiwata Y, Hiyama S, Igarashi K, Ono T, Kuroda T (1997) Human jaw-tongue reflex as revealed by intraoral surface recording. *J Oral Rehabil* 24:857-862.
- Ito T, Szabados A, Caillet J-L, Perrier P (2020) Quick compensatory mechanisms for tongue posture stabilization during speech production. *J Neurophysiol* 123:2491-2503.
- Neilson PD, Andrews G, Guitar BE, Quinn PT (1979) Tonic stretch reflexes in lip, tongue and jaw muscles. *Brain Res* 178:311-327.