

Internship proposal Tongue stretch reflex

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Background:

Stretch reflex is known as one mechanism of human sensorimotor control. When muscle (or limb) was stretched by unknown disturbance, the muscle makes a quick contraction to maintain the same length (or posture). This quick reaction is driven in neurally low-level of network (mono-synaptic connection at spinal cords) and also demonstrates a function of muscle receptors (muscle spindles) which detect a stretch of muscle length. While this has been widely known in limb system as basic sensorimotor function, it is still unknown whether the tongue also has a stretch (or similar) reflex. Although the tongue has muscle spindles, its physiological nature is not examined well (Cooper, 1953). Particularly a previous study failed to induce a stretch reflex (Neilson et al., 1979).

Recently we have carried out an original experiment using a novel technique to stretch the tongue with a robotic device (See Figure 1). The tongue movement in response to the external tongue stretch was recorded and those data showed relatively quick reaction of motion. Although the latency of this reaction was relatively shorter than the latency of voluntary reaction, it is still unclear whether it was driven by reflex mechanisms. Conventionally electromyogram (EMG) is used to examine the reflex by observing directly muscle activation. However, apart from a few studies (Ishiwata et al., 1997), it is very difficult to measure muscle activity without using invasive method 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. The combination of the mechanical perturbation method and the electromyogram should clarify the role of tongue reflex, probably the stretch reflex, in the quick reaction to the perturbation.

Purpose:

The current project is **to examine whether the tongue has a stretch-like reflex**. The study try to induce a muscle stretch using the perturbation technique, and will investigate the muscle response with electromyogram.

Method:

- 1) We will evaluate the electromyogram of the tongue when the tongue shape is changed dynamically using the external perturbation force.
- 2) The project develops the non-invasive method using surface electrodes to measure tongue muscle activity.
- 3) A robotic device (SenSable Technologies: Phantom 1.0) will generate a force to change the tongue shape. The robot will be controlled with Matlab and custom-made control driver (Fig. 1).
- 4) We may also measure tongue movements by using electro-magnetometer (Northan Degital: Wave), if necessary.
- 5) The data set are analyzed using Matlab.

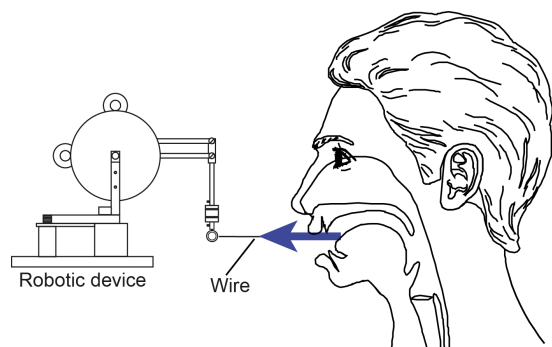


Figure 1: Experimental Setup

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. The student will learn the measurement and analysis method of electromyography for human sensori-motor function together with a physiological knowledge concerning human sensorimotor mechanisms. This internship has developmental and preliminary aspects, but the obtained result would be novel and stimulate further argument for future work.

Reference:

Cooper S (1953) Muscle spindles in the intrinsic muscles of the human tongue. *J Physiol* 122:193-202.

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.

Neilson PD, Andrews G, Guitar BE, Quinn PT (1979) Tonic stretch reflexes in lip, tongue and jaw muscles. *Brain Res* 178:311-327.