Wireless stimulator for tactile sensation

Biomedical Engineering / Thesis advisors: Prof. Dr. Volker M. Koch, Prof. Kenneth J. Hunt
Expert: Prof. Dr. Alejandro Hernandez Arieta
Project partner: Universität Zürich, Artificial Intelligence Lab, Zürich

The sense of touch constitutes a vital feedback for a person during interaction with the environment. The sense-actuate closed loop can be broken in the case of certain pathologies or amputation. With the aim of reestablishing or relocating sensory feedback, this project deals with the development of two portable, dual-channel, wireless, synchronized, transcutaneous electrical stimulators(TES) with output current monitoring. The generated signal is intended to stimulate the tactile sensory receptors located on the lower back.

Project Scope

To study the body's response to stimulation given different stimulation parameters, the stimulator shown in Figure 1 is controlled by a PC via Bluetooth. A GUI has been developed to modify stimulation parameters, switch modes, display output voltage, current and skin resistance.
The stimulation signal as shown in Figure 2 is square and biphasic, aiming to deliver a charge-balanced stimulus. The carrier frequency (1/[*t*1+*t*2]) can be set to a value from 1 kHz to 10 kHz, the envelope frequency (1/*T*p) from 1 Hz to 200 Hz. It is also possible to stimulate continuously with the carrier frequency (*T*p=*t*b). The stimulation amplitude can be chosen from 2.3 V to 30 V.
The output current monitoring feature allows generating similar sensations across the electrodes, independent of changes in the body impedance.

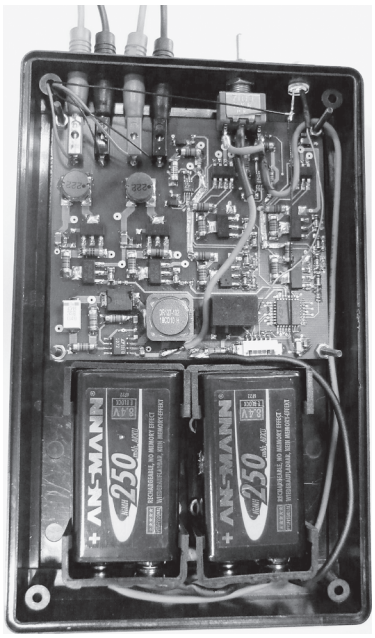
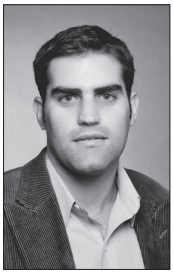


Figure 1. Developed Stimultor.

As shown in Figure 3, a moving sensation can be produced, which is a tactile illusion generated by the synchronized stimulation of tactile receptors by two channels with accordingly rising and falling amplitudes. The stimulus is perceived as a one dimensional movement between the two electrode pairs, which can be used as a form of sensory feedback.

Results and Discussion

The stimulator successfully generates the desired signals and the GUI allows a smooth interaction. Currents are monitored on every positive phase and displayed on the PC where the electrode-skin interface resistance is calculated. Further tests on humans are yet to be performed in order to characterize the body response to the different stimulus parameters.



Daniel Lachner
daniellachner@gmail.com

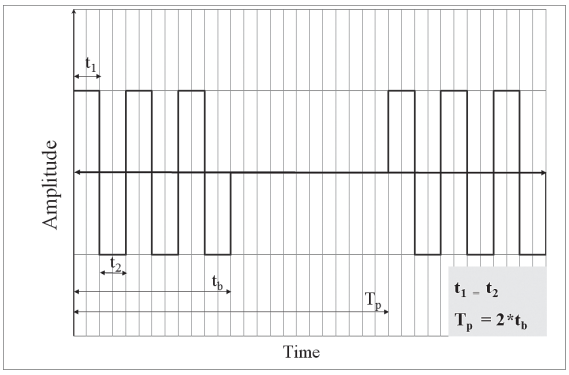


Figure 2. Stimulation Signal

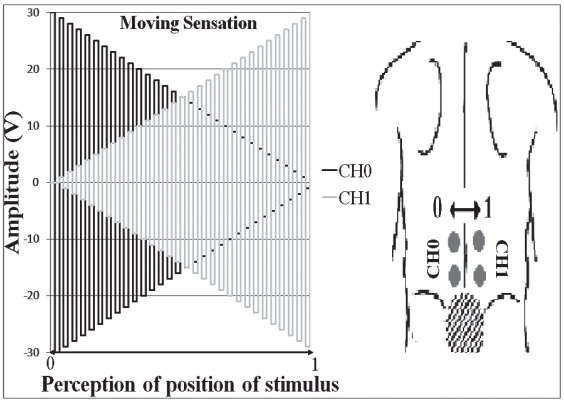


Figure 3. Moving Sensation.