Touch Location and Strength Display by Combining Servomotors and Vibrators

Subject: Mikro-Medizintechnik
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Restoring tactile sensation to a person who lost a hand is vital in order to ensure a lasting success during the rehabilitation phase. The WiseSkin project aims to develop such modern day myoelectric hand prosthesis by deploying a variety of state of the art technologies. The feedback device that was conceptualized and built during the course of this bachelor's thesis restores the sense of touch by combining servo motors and vibrators.

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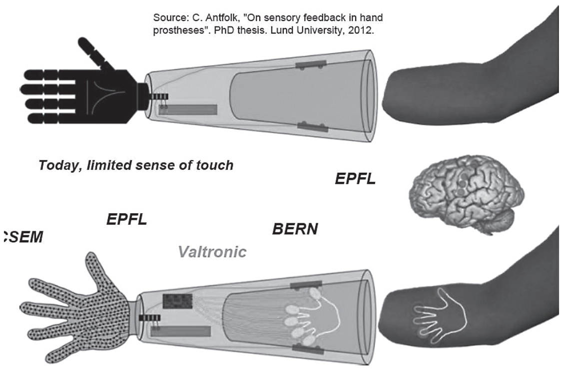
Introduction

The WiseSkin project is a collaboration between EPFL, BFH and CSEM and it is an ambitious project to push the boundaries of modern technology in the field of ultra-low power wireless devices, tactile feedback and miniaturized pressure sensors to create a myoelectric prosthesis**.** The aim of this bachelor's thesis was to develop a non-invasive solution for conveying the natural sense of touch to the user. Furthermore a phantom mapping of the patient allows for accurately stimulating spots on the residual limb that correspond to the lost fingers.

Materials and methods

To create a mechanotactile actuator both rotary and linear commercially available servo motors were subjected to an evaluation to meet size and weight constrains. A small linear servo with the weight of 2.9 grams emerged as viable solution to convey pressure tactile sensation. This particular servo is predominantly found in the steering unit of RC helicopters and superlight foam aircrafts. It generates its force by a miniaturized internal spindle. For the vibrotactile stimulation a cylindrical eccentric rotating mass (ERM) vibrator was selected. It is commonly used in electric toothbrushes and vibrating touch interfaces. Furthermore both the chosen vibrotactile and the mechanotactile device can be considered low cost in comparison with other commercially available state of the art actuators. To allow for selective stimulation according to the phantom map an array of 3x15 actuators was fitted within an area of 118 mm by 118 mm . This roughly corresponds to half the upper arm of on adult male. In addition the display was molded in medical silicone to inhibit any kind of allergic reaction or adverse side effects resulting from extended skin exposure. The actuator control was realized with an Arduino mega board and the corresponding open source Arduino software.



A myoelectric prosthesis on top and below the WiseSkin project with tactile feedback.

Results

The device was successfully built and finally tested together with the miniaturized pressure sensors. During the tests the device appeared to convey both mechanotactile and vibrotactile stimulation in a satisfactory way. Together with the software a great variety of alternating pressure and vibration patterns could be generated. The test person was able to distinguish all five fingers consecutively. A couple of key issues emerged during the field trials such as vibration proliferation throughout the device and high power consumption during sustained periods of applied pressure. Also the device appeared to be bulkier than expected especially when mounted on the chest ward side of the upper arm.

Conclusion

To reach the ambitious goal to convey genuine sensations of touch, the tactile display has to undergo further tests, in particular in the context of the developments in related bachelor's projects like the miniaturized pressure sensor and the myoelectrically controlled hand. The software has to be tailored to the specific needs of each individual amputee and also the phantom map has to provide the foundation and framework to deliver an authentic touch experience. In addition the device itself needs a more efficient way to damp vibrations.