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WiseSkin RTD 2013

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WiseSkin - A Sensor Skin for Hand Prostheses

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Background and Concept of WiseSkin

Amputation of a hand or limb is a catastrophic event resulting in significant disability with major consequences for amputees. Due to a lack of sensory function, the use of functional myoelectric prostheses remains limited. A sense of tactility is needed for providing feedback to perceive the prosthesis as a real part of the body, inducing a sense of “body ownership. WiseSkin is an artificial skin applied to existing hand prosthesis. Miniature, soft-MEMS tactility sensors are embedded into the silicone “skin” covering the prosthetic hand. Event-driven, ultra-low power (ULP) wireless communication is used to transfer sensory data to a sensor fusion block, where the data are processed and used to drive the actuators, which are placed on the phantom map. The sensor skin enhances the functionality of prosthetic products, hopefully offering improved quality of life for amputees.

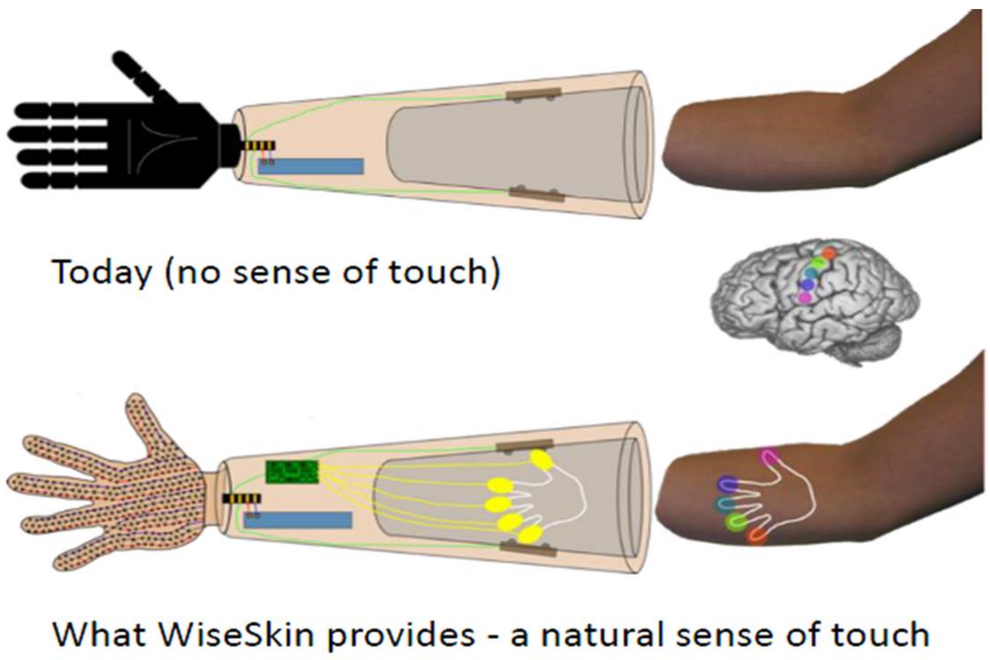

Fig. 1: Comparison between traditional prosthesis without sensors and our novel approach. The WiseSkin solution applies stimuli to the phantom map on the remaining stump of the amputees [1].

Sensory Feedback System Design

At BFH, the work involves investigating sensory feedback, system design, final integration and developing a functional prototype.

Fig.2: Example of phantom map of one amputee [1]

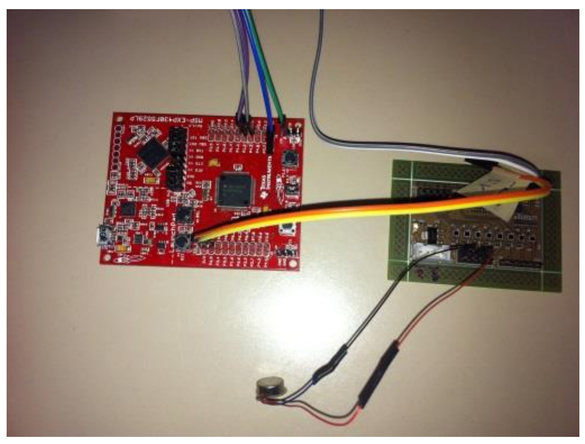

Fig. 3 Stimulation system setup

The sensory feedback system uses the phantom map effect, which many amputees experience a phantom "hand map" in their residual limb. We will use vibrotactile feedback due to its small size, low power consumption and universal psychological acceptance. The challenge is to find a suitable way to code the signal.

Sensory Feedback System Modelling

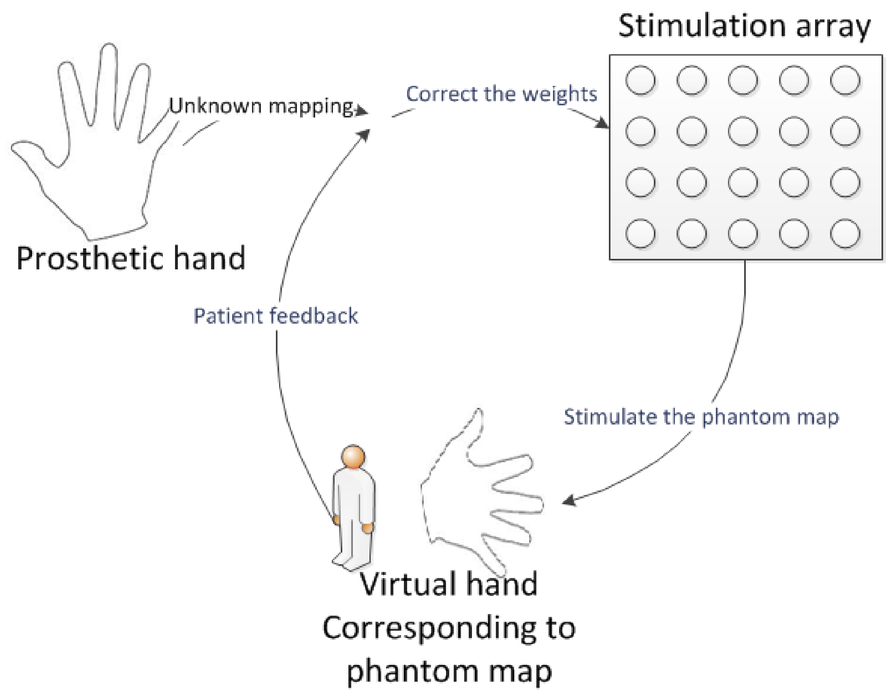

Fig. 3 Sensory feedback loop

The feedback loop has three models: the prosthetic hand model including the sensors, the mapping algorithm model including learning algorithm and the phantom map model. For the loop, the hand model generates sensory data consisting of sensor position, sensory data level (e.g. pressure level) and type of sensors (e.g. shear, pressure). The sensory data is applied to the sensor fusion part which will use neural network. The learning process should be exact, robust and fast. A realistic model of the phantom map will also be implemented.

Conclusion

WiseSkin aims at developing new technology in miniature, ULP sensor and communication devices, advanced, high-density body sensor networks towards artificial skin and tactile robots. It also investigates the sensory feedback stimulation methods and sensor fusion algorithm. The goal of WiseSkin project is to restore a natural sensation of touch, which hopefully will have a profound impact in the daily life of amputees. In the future, the market for WiseSkin-like products could also extend to a variety of other domains such as tactile robots (e.g. pressure, temperature, shear).

[1] J. Farserotu, J. Baborowski, J.-D. Decotignie, P. Dallemagne, C. Enz, F. Sebelius, B. Rosen, C. Antfolk, G. Lundborg, and A. Bjorkman. “Smart Skin for Tactile Prosthetics.” In *Medical Information and Communication Technology (ISMICT), 2012 6th International Symposium on*, 1–8. IEEE, 2012.