What it's about…

Providing a non-invasive solution for restoration of a natural sensation of touch by embedding miniature tactility sensors into the cosmetic silicone coating of prostheses, which acts like a sensory “skin”.

Context and project goals

Amputation of a hand or limb is a catastrophic event resulting in significant disability with major consequences for amputees in terms of daily activities and quality of life. Although functional myoelectric prostheses are available today (e.g. hand), their use remains limited due, in part, to a lack of sensory function in the prostheses. At the same time, as the world population both grows and ages, the number of people living with disabilities, such as persons who have lost limbs for whatever reason e.g. trauma, diabetes or cancer, also increases. A sense of tactility is needed for providing feedback for control of prosthetic limbs and to perceive the prosthesis as a real part of the body, inducing a sense of “body ownership”. Today, there is no solution for restoration of a natural sense of touch for persons using prosthetic limbs.

WiseSkin provides a solution for restoration of the sensation of touch. It embeds tactility sensors into the cosmetic silicone coating of prostheses, which acts like a sensory ‘skin’ providing the sensation of touch, enabling improved gripping, manipulation of objects and mobility (walking) for amputees. Flexibility, freedom of movement and comfort demand unobtrusive, highly miniaturized, ultra-low power (ULP) sensing capabilities built into the ‘skin’, which is then integrated with a sensory feedback system. The focus is on non-invasive (external actuation) sensory feedback mechanisms. The main elements of the project are:

- flexible, skin-like, material embedded with tactility sensors
- miniature, flexible, soft-MEMS based sensors (e.g. pressure, shear)
- ULP, event driven wireless communication (radio and protocol) between the sensors and processing / control module
- a conformal, stretchable powering system based on a metallic mesh grid
- use of the metallization layers as a waveguide
- a system for sensory feedback based on a tactile display (i.e., on the amputation stump or the back) using miniature actuators / electrodes
- Proof-of-Concept demonstrator (i.e., tested on volunteers) combined with brain imaging to investigate neural mechanisms of tactile perception

WiseSkin pushes the forefront of technology in miniature, ULP sensor and communication devices, materials and sensory feedback systems; putting nano-tera research at the forefront. It enhances the competitiveness of Swiss organizations in these domains, helping to open the door for Swiss industry to capture an early and substantial share in the market for advanced, high-density body sensor networks towards artificial skin and tactile robots. Importantly, WiseSkin enables new prosthetic products, with improved functionality, hopefully offering improved quality of life for amputees.
How it differentiates from similar projects in the field

Today, there is no solution for restoring a natural sense of touch to persons using prosthetic limbs.

Additionally, the WiseSkin approach targets the ability to cover large areas (i.e. much more than a sensor node at the tip of a finger).

Quick summary of the project status

Accomplishments include:

- Development of the first sample of the artificial skin with dual layers for powering and waveguide and test
- Paper presented at the International Symposium on Medical Information and Communication Technology 2014 (ISMICT 2014) concerning the number and location of sensors and the power budget.

Main publication