NEURAL CODE IN TOUCH AND HEARING
SENSORY PERCEPTION AND SENSORIMOTOR CONTROL:
FUNDAMENTAL NEUROSCIENCE, MEDICINE, BIONICS, ROBOTS

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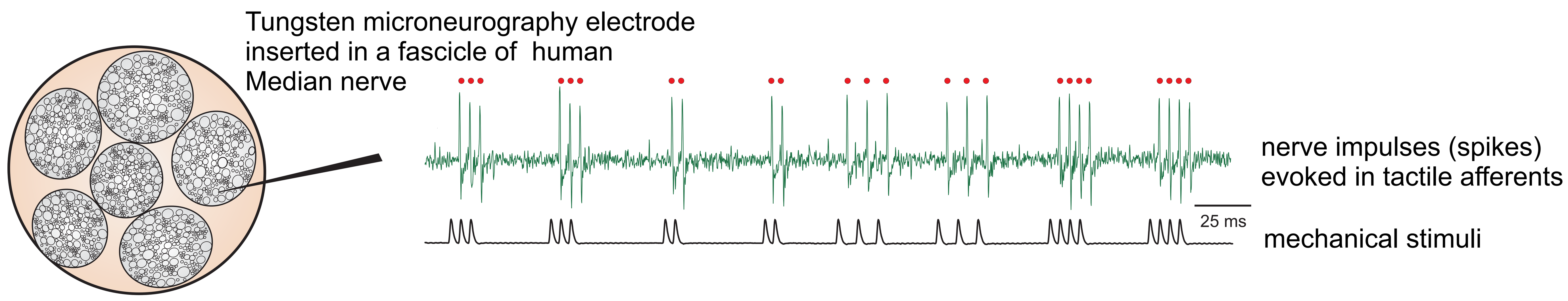
Join us for live chat at: https://unsw.zoom.us/j/88361779586?pwd=4-xOZiSTs0ekpORvrnPD-4EQy7BMr6.1

The overall goal of our research is to unravel the neural sensorimotor mechanisms that endow humans with their extraordinary ability to manipulate physical objects with their hands. Aims of our projects are to (i) to understand how the brain works; (ii) understand what happens and how to help in pathological conditions, and (iii) to implement our knowledge in development of artificial sensors and control algorithms for robotic manipulators, intelligent prostheses and brain-machine-interfaces.

METHODS:

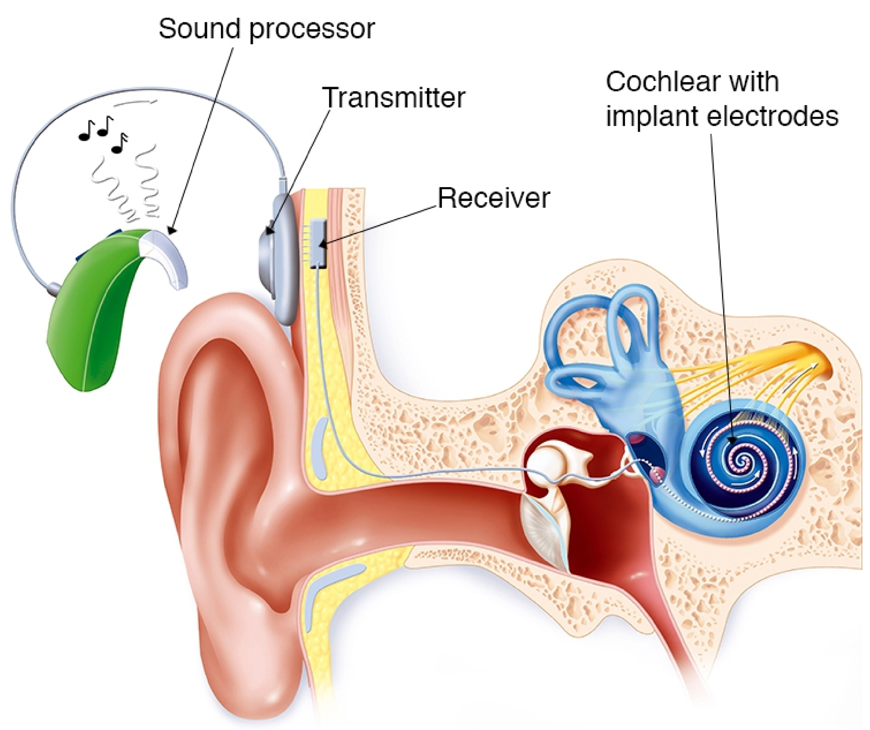
- **Human microneurography** – a unique method which allows us to tap into the signals single sensory axons are sending to the brain. Using fine needle electrodes inserted into a peripheral nerve we are able to analyse tactile neural signals in awake humans with a precision and resolution previously available only in animal experiments
- **Psychophysics**
- **Computer modelling**, simulations, robotics (collaboration with biomedical engineers)
- Investigations in **patients (stroke, diabetic or chemotherapy induced peripheral neuropathy)**

Encoding and sending messages to the brain: method of creating precisely-controlled temporal patterns of spike trains



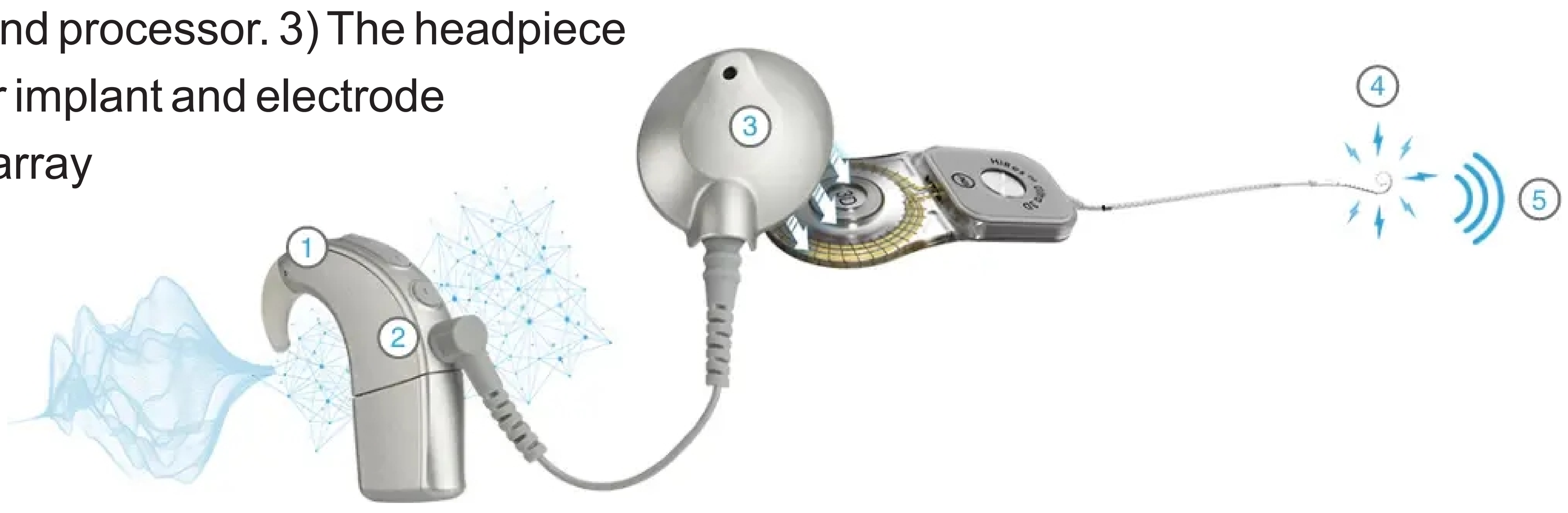
To investigate how tactile afferent information is encoded and interpreted by the brain we have developed a unique methodological approach enabling us to evoke precisely-controlled temporal patterns of spike trains in rapidly adapting afferents using a computer-controlled mechanical stimulator. Because of the very brief movement (2 ms), each pin protraction generates only a single time-controlled spike in each responding peripheral afferent. We can, therefore, precisely control the timing of each spike and so generate an arbitrary pattern of spike trains in the responding afferent.

Auditory system and cochlear implants

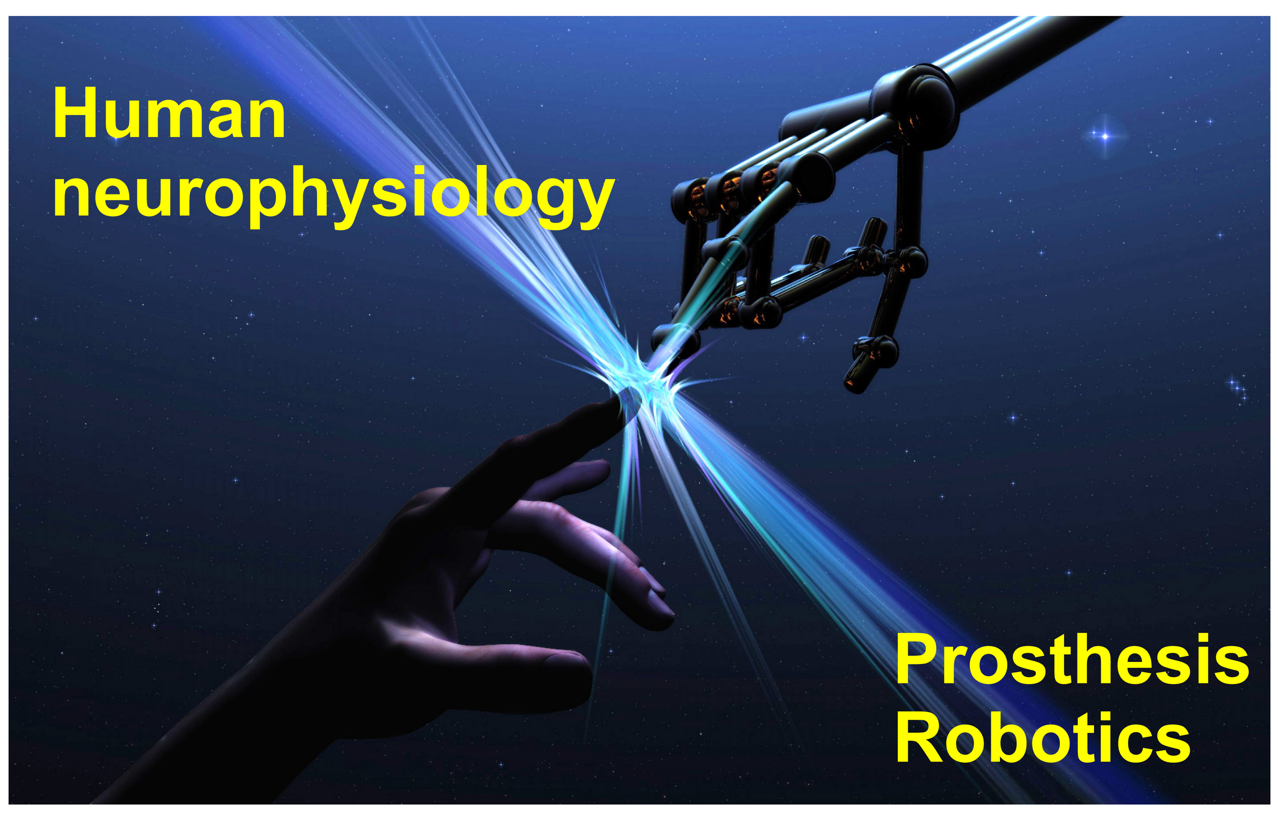


Auditory and tactile systems share some neural code features

Some of our research projects are investigating the neural coding mechanisms in auditory system. We test perceptual phenomena using different sound patterns in individuals with normal hearing. We also test pitch and loundness perceptions in patients with cochlear implants. 1) The microphone captures sound waves. 2) The sound waves are converted into digital signals by the sound processor. 3) The headpiece sends the digital signals to the cochlear implant and electrode array in the inner ear. 4) The electrode array stimulates the hearing nerve. 5) The hearing nerve sends impulses to the brain, which interprets them as sounds



Sensorimotor control mechanisms underpinning hand dexterity



More information about projects:
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https://research.unsw.edu.au/people/associate-professor-ingvars-birznieks
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