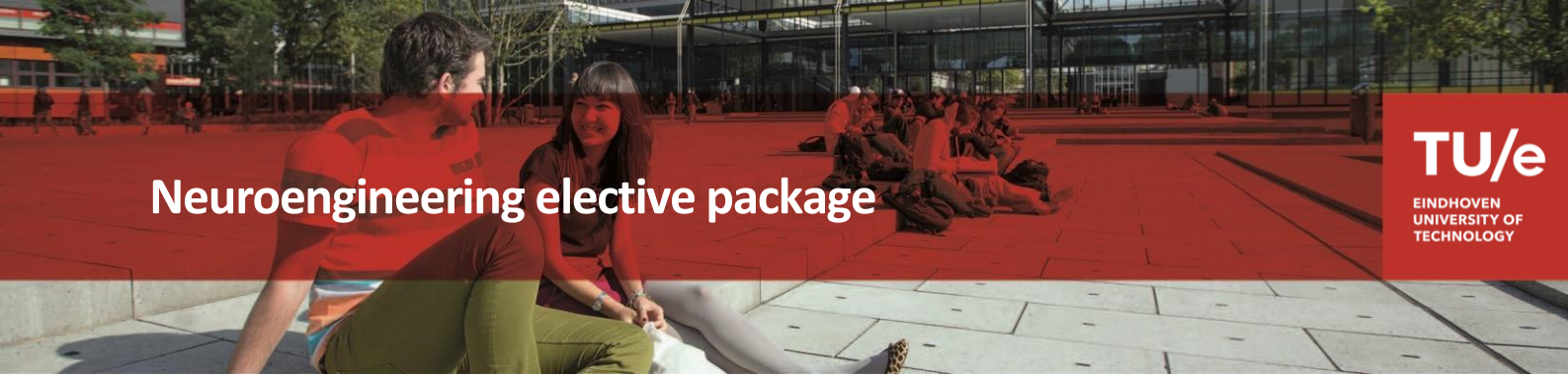


Neuroengineering elective package

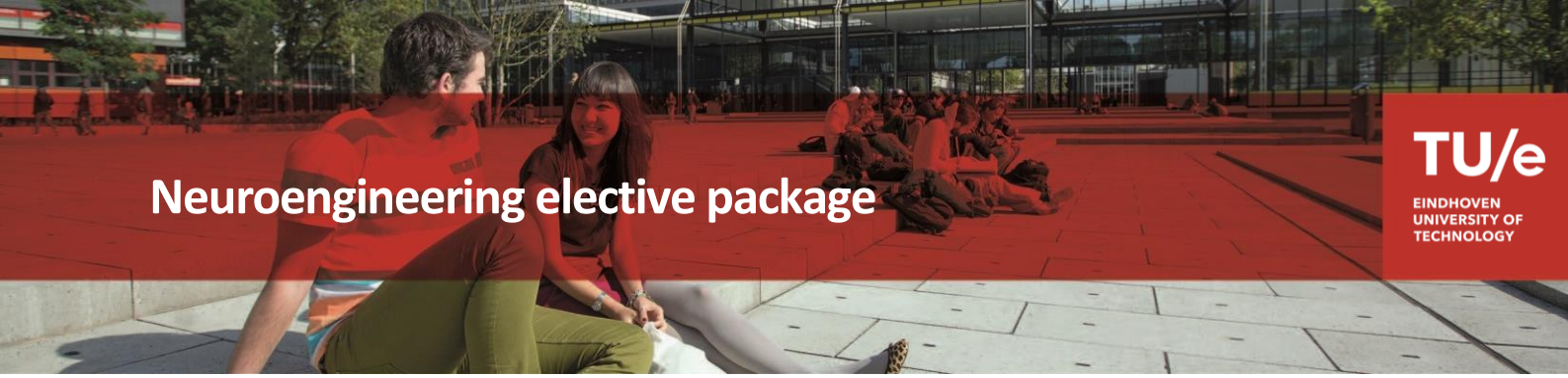
Title elective package	
Offered by	Department of Electrical Engineering
Language	English
Primarily interesting for	All students, but most relevant for students with background in EE, TN, BMT (with additional requirements)
Prerequisites	Required courses: • the course 5ESC0 (DSP fundamentals) or the course 8VB10 (Measurements and modeling in the clinic); • Circuits (5ECA0) or equivalent, Electromagnetics I (5EPA0) or equivalent is needed (or at least strongly recommended).
Contact person	dr. S. Zinger, s.zinger@tue.nl

Content and composition

Course code	Course name	Level classification	Last year course is offered	Last year exam is offered
5XPC0	Neurophysiology and neurostimulation	Deepening	2022	2022
5XSH0	Cognitive neuroscience	Deepening	2022	2022
5XSA0	Introduction to medical image processing	Advanced	2022	2022

Course description

Neurophysiology and neurostimulation (5XPC0)
Information processing in the brain is governed by bioelectrical and biochemical processes in and among neurons. These processes can be simulated using electrical networks that model the capacitive properties and dynamic conductive behavior of excitable cell membranes. In this course, such models are used to explain and simulate action potentials (neural spikes), postsynaptic potentials and information conduction across neuronal cell membranes. Next, the scope of the course is extended towards the collective bioelectrical behavior of populations of neurons and the currents they cause in the extracellular space. These currents are the sources of the surface field potentials that can be measured as Electroencephalographic (EEG) , Event Related (ERP) and/or Sensory Evoked Potentials (SEP) at the skin using electrodes. The interpretation and clinical use of surface macropotentials to a large extent is based upon experimental evidence from medium or large size clinical studies carried out under various conditions (e.g. before, during and after medical treatment) within and across various groups of patients and healthy controls. The last part of the course, therefore, is dedicated to biostatistics and hypothesis testing. For this course, prior knowledge of Circuits (5ECA0) or equivalent, Electromagnetics I (5EPA0) or equivalent, is needed (or at least strongly recommended). This is especially relevant for non-EE students (contact the responsible teacher when in doubt).



Neuroengineering elective package

Cognitive neuroscience (5XSH0)
Cognitive neuroscience is the study of higher cognitive functions in humans and its underlying neural bases. This course explores the cognitive and neural processes that support attention, vision, language, motor control, problem solving and memory. It introduces basic neuroanatomy, imaging approaches and behavioral measures of cognition, and discusses methods by which inferences about the brain bases of cognition are made. We consider evidence from patients with neurological diseases (Alzheimer's disease, Parkinson's disease, Huntington's disease, Balint's syndrome, amnesia, and focal lesions from stroke) and from normal human participants.

Introduction to medical image processing (5XSA0)
The final course in this elective package will provide you with more in-depth knowledge on medical image processing. It starts with an introduction into multi-dimensional signal processing. Then, the core techniques, such as feature detection/extraction, image enhancement and segmentation are discussed. The basic classification techniques are considered so that notions of machine learning are provided. Finally, new developments in applications (e.g. CT/MRI, image-guided surgery) are presented.