

Neuroengineering elective package

Neuroengineering	
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: - Recommended courses: -
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Content and composition

The nervous system controls our voluntary and involuntary actions. Its main organ, the brain, harbors our intelligence. In recent decades our understanding of the nervous system has increased strongly, and engineering approaches are emerging to study the nervous system, and to diagnose and treat neurological diseases such as Parkinson's disease, stroke, epilepsy, and Alzheimer's disease. This elective package provides an introduction to the booming neuroengineering field. It consists of 3 courses taught by experts from TU/e and from the neurological field. Students taking this program have the opportunity to do their final Bachelor project in this context so as to obtain real-world immersion in the subject matter.



Course code	Course name	Level classification
5XPC0	Neurophysiology and neurostimulation	-
5XSH0	Cognitive neuroscience	-
5XSA0	Introduction to medical image processing	-

Important notes:

- The courses in this package can only be chosen as coherent package, not as stand-alone courses.
- For 5XPC0, prior knowledge of Circuits (5ECA0) or equivalent and Electromagnetics I (5EPA0) or equivalent is needed. This is especially relevant for non-EE or non-TN students.
- For the course 5XSH0, 5XPC0 is required as prior knowledge.



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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.

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.