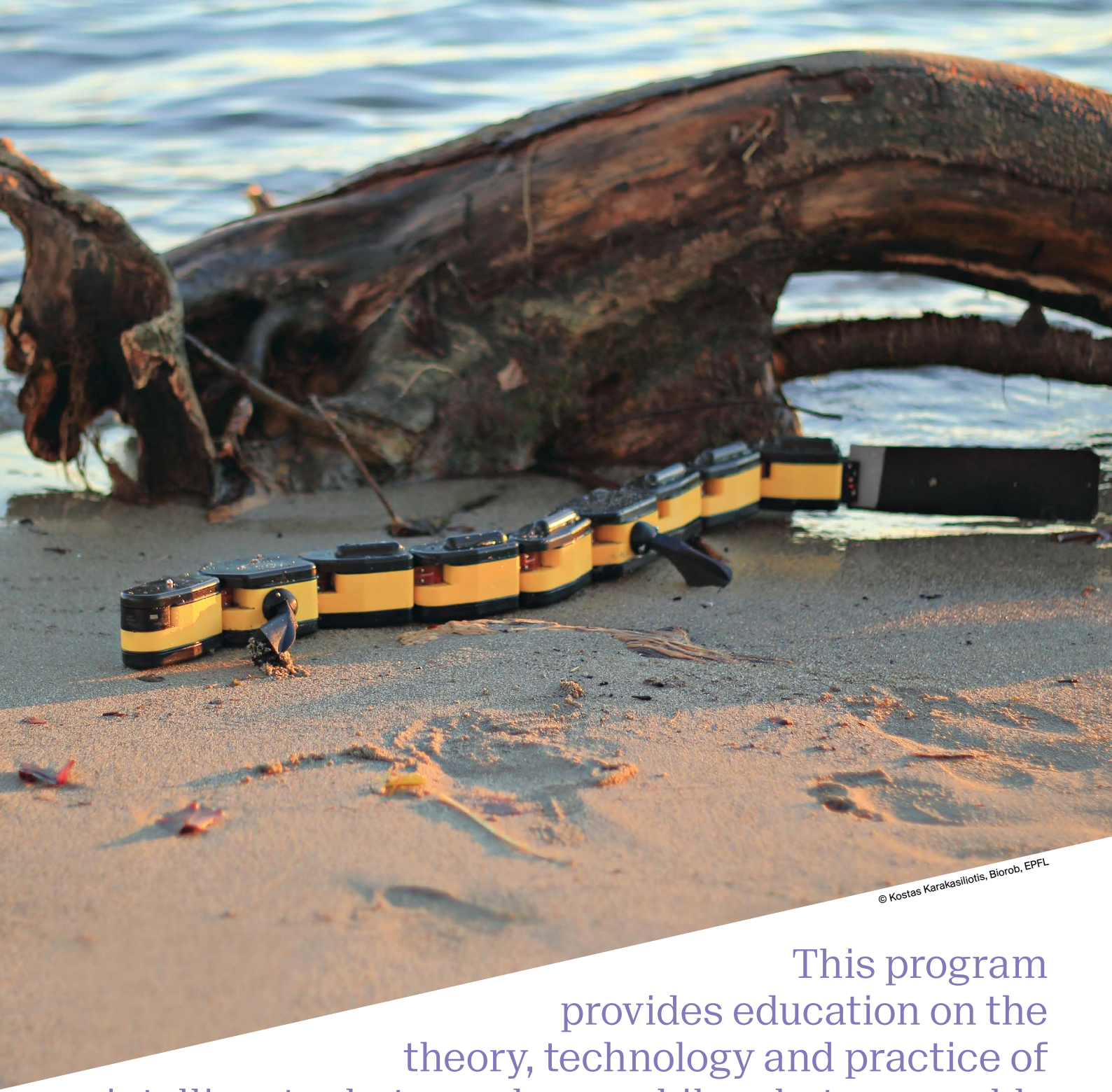
ROBOTICS

MASTER

EPFL



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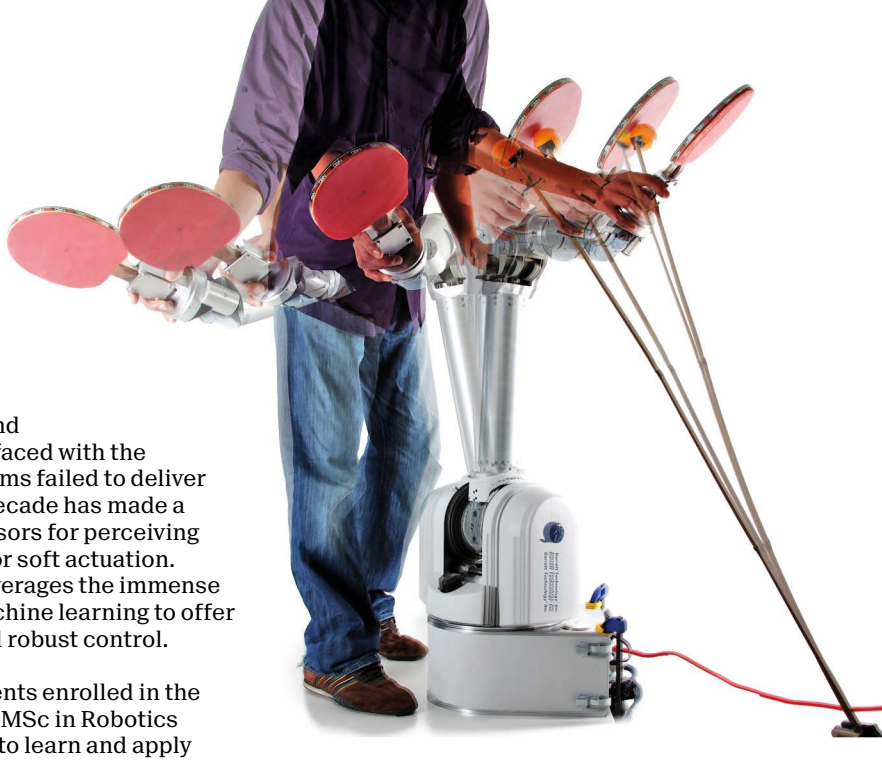
This program provides education on the theory, technology and practice of intelligent robots, such as mobile robots, wearable robots, robotic manipulators, autonomous and brain-interfaced robots. In addition to classes spanning from electromechanical systems to advanced artificial intelligence, the program offers a large set of hands-on activities where students learn by designing, prototyping and validating robotic systems.

Robotic manipulation



Dexterous manipulation of objects is robotics 21st century primary goal and a cornerstone of industry 4.0. For decades, robotic manipulation was reduced to grasping a static object. Algorithms were derived from the mathematical models of these robotic systems, and optimized for this particular purpose. Yet, when faced with the uncertainty of the real world, these algorithms failed to deliver their theoretical promises. The past decade has made a leap forward. It benefits new sensors for perceiving touch and new mechanics for soft actuation. Most importantly, it leverages the immense progresses in machine learning to offer adaptive and robust control.

Ilaria Lauzana: "This master's program at EPFL allows you to get practical in so many ways. Once you get your diploma, you know you are ready for your future, be it in academia, in industry or in your own startup."

Students enrolled in the EPFL MSc in Robotics will get to learn and apply machine learning techniques to teach robots to manipulate objects. In the compulsory robotic practicals, students will get to train robots to recognize objects and stack them to build complex structures. Students will also be able to work on research projects as part of semester projects and master theses conducted in the LASA laboratory. In these projects, students will participate in developing new algorithms to control forces in the event the robot may enter in contact with a human to ensure safety. They will also get to know about methods for multi-arm manipulation for manipulating objects on fast moving conveyor belts.

Portable bidirectional artificial hand prosthesis

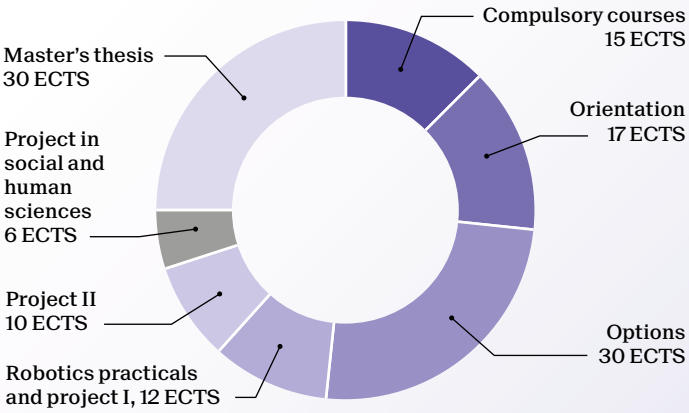
This project aims at designing and testing a portable bidirectional prosthesis to amputees restoring motor and sensory functionalities lost with the healthy limb. In order to perform chronic experiments over several weeks with the patients, the system must be fully portable, comfortable for the patient, and able to run on battery power for at least a whole day. The system should be small in both size and weight, optimized for real-time execution, and designed to be as versatile as possible. During their master's thesis, students were asked to develop and clinically evaluate a neuro-controlled upper limb prosthesis intuitively controlled and felt by the amputee as the natural one. At the end of the project, the proposed embedded system showed high levels of performance and imperceptible delays. The device can be used with battery power over long periods of time. These characteristics make this the first embedded computing device designed to be integrated in a real-time bidirectional hand prosthesis. The designed system is modular and highly adaptable. It can thus successfully be considered as a major first step in the direction of a fully embedded, fully portable system.

Thibault Asselborn: "This master's degree gave me the opportunity to develop a strong theoretical background and perform research within the world's most prestigious laboratories."

Master of Science in

ROBOTICS

2-year program - 120 ECTS



The program includes a compulsory industrial internship with a minimal duration of 8 weeks.

Students must choose 17 ECTS of optional courses in one of these three orientations:

A Industrial robotics
B Medical robotics
C Mobile robotics

They may choose a minor instead of the optional courses (30 ECTS):

If the chosen minor includes a practical project, the Project II (10 ECTS) is completed by the minor's project and students can therefore choose 10 ECTS of optional courses.

Recommended minors with this program:

- Biomedical technologies
- Computer science
- Energy
- Engineering for sustainability
- Imaging
- Neuro-X
- Photonics
- Physics of living systems
- Quantum science
- Space technologies

Prerequisites for admission

Candidates holding an EPFL bachelor's degree in microengineering are automatically accepted. Holders of a bachelor's degree in computer science, electrical engineering, mechanical engineering, or any related field with an interdisciplinary background can apply and will go through the standard EPFL admission procedure.

School of Engineering
go.epfl.ch/master-robotics
contact: smt@epfl.ch

	Credits
Basic compulsory courses	**15**
Applied machine learning	4
Basics of mobile robotics	4
Basics of robotics for manipulation	3
Model predictive control	4

	Orientations			
Optional courses and orientation	**A**	**B**	**C**	**47**
Advanced control systems	A	B	C	3
Advanced machine learning	A	B	C	4
Advanced mecanisms for extreme environments		B	C	3
Advanced MEMS and microsystems			C	3
Advanced satellite positioning			C	4
Aerial robotics			C	4
Analyse de produits et systèmes	A			2
Applied and industrial robotics	A			2
Applied data analysis	A	B	C	8
Architecture software	A	B	C	3
Basics in bioinstrumentation		B		4
Commande embarquée de moteurs	A			3
Commande non linéaire	A	B	C	3
Computational motor control		B	C	4
Computer vision	A	B	C	6
Continuous improvement of manufacturing systems	A			5
Controlling behavior in animal and robots		B	C	4
Convex optimization	A	B	C	5
Deep learning			C	4
Deep learning for autonomous vehicles			C	6
Deep learning for optical imaging	A	B	C	3
Distributed intelligent systems			C	5
Embedded systems design	A	B	C	6
Energy supply, economics and transition	A	B	C	2
Evolutionary robotics			C	3
Haptic human robot interfaces	A			3
Image analysis and pattern recognition		B	C	4
Image processing I, II	A	B		6
Industrial automation	A			3
Intelligent agents	A		C	6
Interdisciplinary project				10
Introduction to bioengineering		B		3
Learning and adaptative control for robots			C	4
Legged robots			C	4
Lifecycle performance of product systems	A			3
Machine learning for predictive maintenance applications	A			4
Machine learning programming	A	B	C	2
Management de projet et analyse de risque	A	B	C	4
Mechanical product design and development	A	B	C	5
Micro- nano robotics	A	B	C	3
Multivariable control			C	4
Networked control systems			C	3
Neural interfaces		B		6
Neural signals and signal processing		B		6
Numerical methods in biomechanics		B		3
Optimal decision making	A			4
Organic and printed electronics		B	C	2
Principles of finance	A	B	C	5
Production management	A			5
Reinforcement learning	A	B	C	6
Sensor orientation			C	4
Sensors in medical instrumentation		B		3
System identification	A	B	C	3
Systèmes mécatroniques	A	B	C	5
System programming for Systems-on-chip	A	B	C	6
Translational neuroengineering		B	C	6