# Highly integrated series elastic actuator for medical robotics

Master Thesis of 6 months at BIROMED-lab in Allschwil and in maxon offices in Zurich Oerlikon.

## About BIROMED-lab

We develop bio-inspired robotic and mechatronic systems for medical applications focusing towards minimally invasive laser osteotomy. We work on design, prototyping, control, actuation, and sensing of novel robotic endoscopes.

## About maxon

We develop and build electric drive systems that are among the best in the world. Our drive systems can be found wherever extreme precision and the highest quality standards are indispensable – on Earth, and on Mars.

## Motivation

Series elastic actuators offer interesting characteristics for robotics in non-characterized environments. Such actuators consist of an elastic spring element in series with the electric motor. The elastic element allows to tune the impedance of the drive and it can be used to estimate the torque applied to the load.

In this thesis we aim to develop a highly integrated series elastic actuator for use in a medical robotic application. The applicability of the series elastic actuator for the application is proven using stand-alone components. With higher integration we aim to reduce cost, volume required and increase ease of integration into the robotic application.
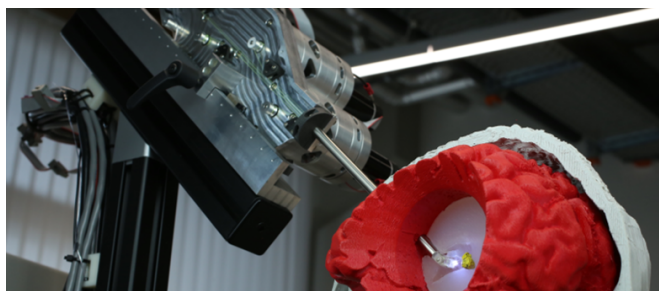


## Main challenges:
- selecting optimal components (motor, electronics, sensing) w.r.t. compactness, cost, and bandwidth;
- mechanical and functional integration into a compact drive system;
- implementation of the drive control system with integrated torque sensing in C.

## You will:
- analyze the existing solution (picture right) of the drive consisting of stand-alone components (motor, encoders, electronics, control and elastic element);
- adapt the maxon drive system optimization toolbox in MATLAB for series elastic actuators and conduct an optimization with the aim of improving performance and decreasing cost;
- develop a mechanical integration concept and implement control of the series elastic actuator in C;

## You are a perfect fit if you:
- are studying towards a degree in robotics, mechatronics or a related field;
- are curious, independent and motivated to work with academic and industry experts;
- possess strong skills in control systems and mechanical design;
- have programming (C) and scripting skills (Python, MATLAB).

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