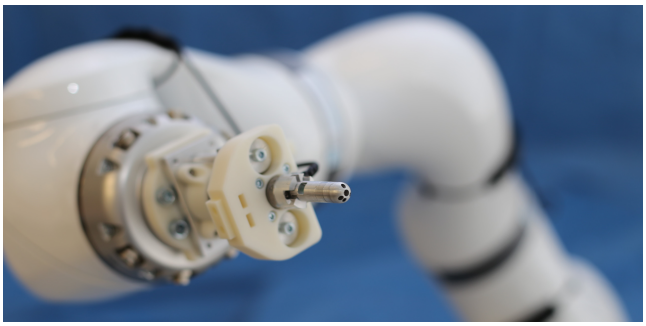
University of Basel

Department of Biomedical Engineering

Bio-Inspired RObots for MEDicine-Laboratory



Force-sensitive Endoscopic Tip Prototype (picture: I. Sušić)

Team Photo 2019 (picture: T. Schürch)

The BIROMED-Lab develops bio-inspired robotic and mechatronic systems for medical applications. The main research focus of the BIROMED-Lab is minimal invasive semi-autonomous robotic surgery for laser ablation of hard tissue (bone). Our portfolio includes knowledge in mechatronics, mechanical design, micro machining, robotics, control, and real-time data processing. Due to our expertise, we maintain also strong collaborations in the fields of robot-assisted gait and arm rehabilitation.

We are developing an entire surgical platform that will consist of several dedicated subsystems for positioning and stabilization of the robotic endoscope, flexible robotic endoscopes for single port surgery, new technologies in force sensing for endoscopes, intuitive telemanipulation interfaces, highly integrated optics, and spray systems for endoscopic laser surgery. To achieve repeatable high precision cuts in minimally invasive procedures, our endoscope tip attaches to the target tissue and decouples mechanically from the endoscope avoiding disturbances. Cutting will be performed in a semi-autonomous procedure, where the robotic endoscope tip moves the laser along pre-planned trajectories, while the surgeon surveys the cutting process and has the possibility to intervene at any time. We investigate novel teleoperation interfaces and control modes to enable intuitive, novel surgical procedures for robotic laserosteotomy.

The BIROMED-lab was founded in May 2016 as part of project MIRACLE. We employ eight PhD-students and collaborate with ETH Zurich (Sensory-Motor Systems Lab), University of Zurich (Paralab), Technical University of Innsbruck, MCI Innsbruck, Reha-Stim Med tec AG (Schlieren), and AOT AG (Basel).

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Selected Publications:

G. Rauter, N. Gerig, R. Sigrist, R. Riener, and P. Wolf, "When a robot teaches humans: Automated feedback selection accelerates motor learning," *Science Robotics*, vol. 4, no. 27, p. eaav1560, Feb. 2019.

M. Eugster, P. Cattin, A. Zam, and G. Rauter, "A Parallel Robotic Mechanism for the Stabilization and Guidance of an Endoscope Tip in Laser Osteotomy," in *IEEE Conference on Intelligent Robots and Systems (IROS)*, pp.1306-1311, 2018.