University of Basel

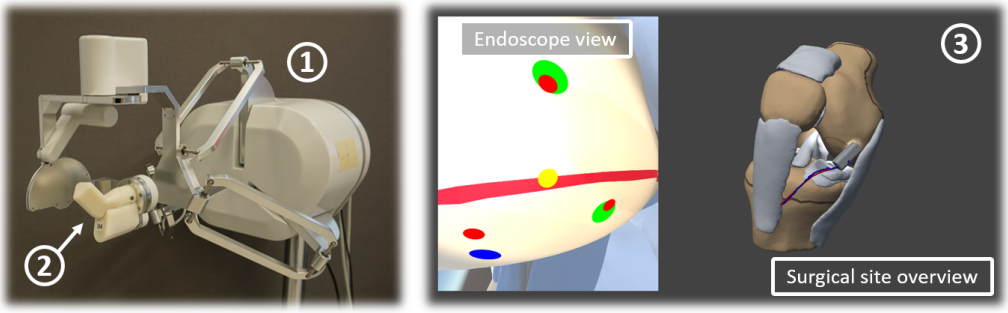
Project MIRACLE
Medical Robotics and Mechatronics
BIROMED-Lab

Department of Biomedical Engineering

Semester Thesis:
3-DoF Haptic Guidance for Intuitive Teleoperation of a Robotic Endoscope

Context: This thesis is part of an interdisciplinary project called Minimally Invasive Robot Assisted Computer-guided LaserosteotomE (MIRACLE) that is carried out at the Department of Biomedical Engineering of the University of Basel. The principal aim of this project is the development of a minimally invasive robotic endoscope for cutting bone with laser light.

Project description: In this project, you will support our interdisciplinary team in developing an intuitive haptic guidance algorithm for the teleoperation of the robotic endoscope. This setup currently consists of a 6 degree of freedom (DoF) haptic master device (1) with a custom handle (2) and a virtual environment (3) that simulates the slave environment. The goal of this thesis is to adapt and extend an existing haptic guidance algorithm for the lambda.6 haptic device in order to improve the usability of the teleoperation system for the approach of the endoscope to the target pose inside the human body.



Your tasks:

- Literature research: You will get familiar with the available literature in the field of haptic guidance in teleoperation, specifically in robot assisted surgery, and motivate your work based on what you find.
- Algorithm adaptation: You will adapt an existing control algorithm in order to provide stable 3-DoF haptic guidance (position only) for a path following task using the lambda.6 master device and a virtual slave endoscope end-effector.
- Algorithm development: You will extend the adapted algorithm such that it is capable of guiding the endoscope end-effector to the desired target pose once its pose is within a predefined threshold from the target pose.
- System evaluation: Finally, you will conduct a small pilot study to investigate if the developed haptic guidance allows the telemanipulation of the endoscope end-effector according to the requirements deducted from the literature research. This will include both a simulation of the controller given a certain user input/behaviour as well as experimental results with human users.

Duration: 240 hours, 5 months part-time
Start: October 2018
End: February 2019

Student:
Gabriel König

Supervision:
Esther Zoller, PhD student
Dr. Nicolas Gerig, Postdoc
Professor: Prof. Dr. Georg Rauter
Professor ETH: Prof. Dr. Robert Riener

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