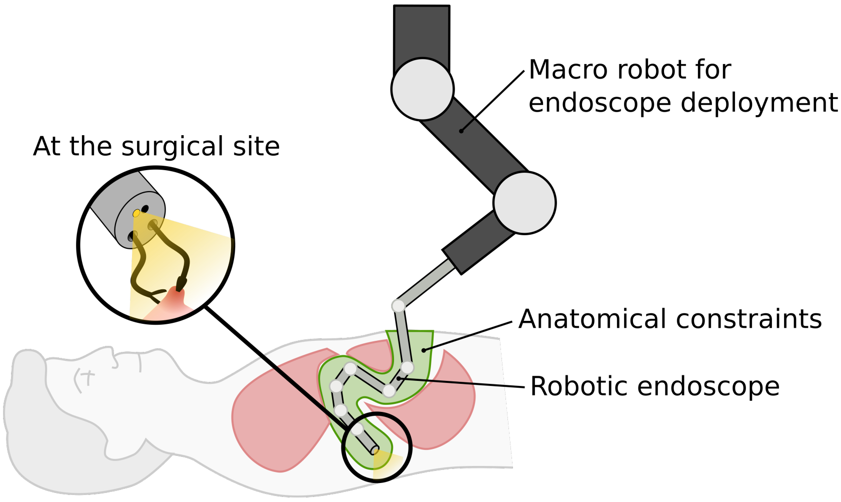
University of Basel
Department of Biomedical Engineering

BIROMED-Lab
Medical Robotics and Mechatronics

# Master Thesis: Optimization-Based Design of a Robotic Endoscope for Intraventricular Tumor Surgery

**Context:** In recent years, more and more robots have found their way into operating rooms and enabled or improved minimally invasive surgeries, where the size and number of skin incisions are kept to a minimum. Advantages of minimally invasive surgeries include the reduction of tissue stress, postoperative pain and a faster healing process. However, for the surgeon, manual handling of instruments through a small incision is difficult and robots can help to perform these interventions faster and with greater precision. Within the MIRACLE project, we are working on equipping a surgical macro robot with an articulated robotic endoscope, which enables to automate certain surgical tasks inside the body.

To reach the location inside the body where the surgical task is performed, the endoscope has to be steered along a path without touching and damaging the surrounding tissue. Naturally, this path depends on the surgical application and the anatomy of the surgical site. One way to achieve that the endoscope can follow along a certain path is to optimize the endoscope structure (e.g., endoscope diameter, number of joints, length of segments) for a specific surgery.




**Task description:** In this project, you will develop a design method to optimize the structure of a robotic endoscope for a specific surgery (intraventricular tumor surgery). This includes the following work packages:

- Literature Research / Requirements Analysis: Conduct research on optimal design, motion planning, inverse kinematics. Gather information about the surgery and analyze the requirements that this surgery will impose on the endoscope (size, anatomical trajectory, etc.).
- Design Optimization: Get familiar with state-of-the-art motion planning tools and develop a method to use them to optimize the design of the endoscope. Use preoperative data to define a desired trajectory and set the optimization criteria such that the resulting structure is suitable to follow the defined trajectory.
- Evaluate your method with respect to the initial requirements.

Student: Omar Garrido
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Duration: 6 months

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