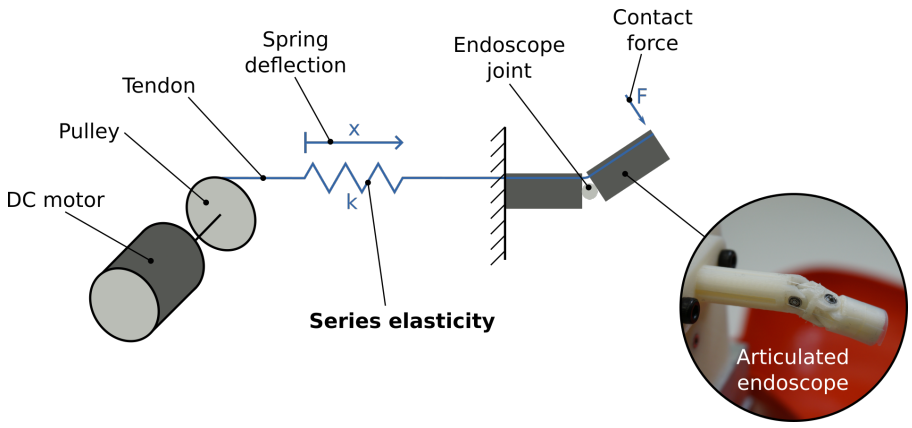
University of Basel

Project MIRACLE
Medical Robotics and Mechatronics
BIROMED-Lab

Department of Biomedical Engineering

# Semester Project:
# Design of Series Elastic Actuation for a Cable-Driven Articulated Endoscope

**Context:** In recent years, more and more robots have found their way into operating rooms. Some of them enabled or improved minimally invasive procedures, i.e. procedures with a minimal number and size of skin incisions. Advantages of minimally invasive surgeries include the reduction of postoperative pain and a faster healing process. 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. We are working on equipping a surgical robot with a dexterous, snake-like tool called an articulated endoscope, which allows to automate certain surgical tasks inside the body. In medical applications, safety is of utmost importance. One concept to increase safety of human-robot interaction is the use of series elastic actuators, where an elastic element, e.g. a spring, is incorporated in the motion transmission. By measuring the deflection of the spring, the applied force of the actuation can be estimated. Therefore, series elastic actuation enables a stable, low noise force control of the robot. This has been applied to other fields of robotics, we also want to successfully implement it on a smaller scale in flexible endoscopes.




**Task description:** Recently, a robotic articulated endoscope prototype was developed at the BIROMED-Lab (Department of Biomedical Engineering, University of Basel). Thus far, two electric motors allow to control the endoscope via tendons in two degrees of freedom. Your task is to redesign the actuation of the endoscope, which includes:

- Conducting a literature research on different architectures and designs of series elastic actuators and in particular their combination with cable-driven mechanisms
- Integrating series elastic elements in the actuation / transmission system to obtain an estimate of the actuation force by measuring the deflection of said elastic elements
- Implementing stable force control of the endoscope and evaluating it in a simple test setup

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Start: March 2019, Duration: 4 months

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