MyoRobot v.2.1
Auto-focus LWD optics system for tracking structure-function relationships in single muscle fibers

The newly developed MyoRobot v.2.0 biomechatronics system for pre-clinical muscle diagnostics and bio-material testing shall be expanded by an auto-focus optics system featuring long-working-distance (LWD) optics. The current optics shall be replaced by an improved LWD and infinity corrected objective system that accounts for spherical and chromatic aberration and features auto-focus functionality. Therefore, the student will design and construct an elevation optics platform operated by a servo motor and automatically accounts for sub-millimeter focus changes during biomechanics function recordings in the system. The optics system will be adjusted on the elevation platform and accounted for its resolution and magnification power to be compared to the previous version. For this, resolutions grids will be used, and quantification can be complemented by ray-trace simulations in Zemax (optional). The auto-focus will be based on image data obtained by the CMOS camera (image acquisition software is provided). In a final stage, the optics system will be compared and validated in biomechanics structure-function relationship experiments on single muscle fibers. The techniques for single muscle fiber preparation will be taught at the beginning of the project. Biomechanics experiments will focus on active/passive force in relation to different or altering sarcomere length or involve sarcomere length tracking during contraction- or stretch-kinetics (e.g. calcium-/drug-sensitivity between 2.0 and 3.0 µm sarcomere length or hysteresis in resting-length tension relationships).

The applicant should be interested (or already have experience) in:
- Technology development in a medical-/health-related context
- Software development with LabVIEW (for motor and camera control)
- Image processing and pattern recognition techniques/algorithms
- Basic optics principles of microscopes and optics simulation

Any further information regarding the MyoRobot system are listed below. If you feel interested and/or challenged, please contact Dr. Michael Haug (michael.haug@fau.de) or Mrs. Barbara Reischl (barbara.reischl@fau.de).

![Image of MyoRobot v.2.1 system](image)

Figure 1. Optics system upgrade to implement auto-focus functionality and LWD objective optics. A, photograph of the current MyoRobot v.2.0 biomechatronics system with optics lens system (enlarged). B&C, components for implementing LWD optics using a commercial objective, deflection prism and a CMOS camera sensor. D, simplified sketch detailing the infinity optics ray guidance.

Literature and Links:
- Versatility of active/passive Material Testing on Muscle Tissue with the MyoRobot. [https://www.mbt.tf.fau.de/research/research-groups/muscle-biomechatronics/the-myobot-prototype/2/]