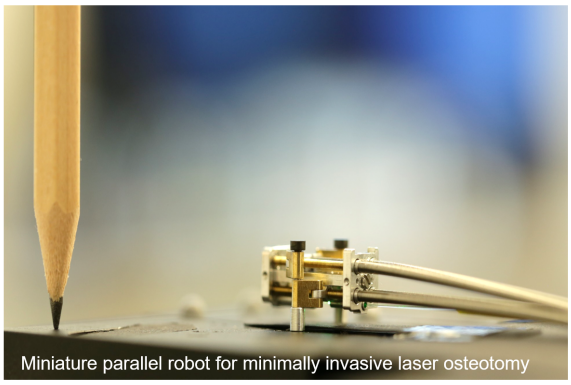
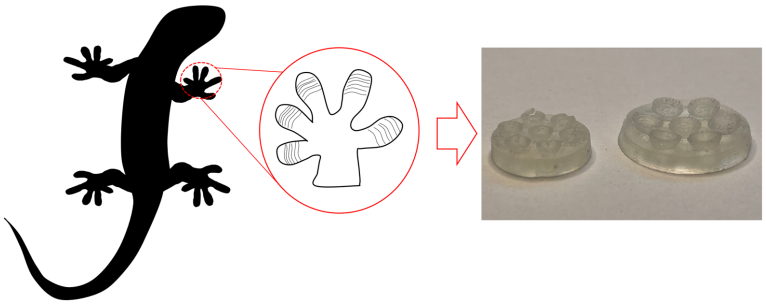
University of Basel
Department of Biomedical Engineering

BIROMED-Lab
Medical Robotics and Mechatronics

Master Thesis:
Development of attachment mechanisms for a minimally invasive surgical robot

Context: Minimally invasive surgeries, i.e., procedures with a minimal number and size of skin incisions, offer many benefits to the patient but are more challenging for surgeons to perform. Robotic systems with some level of autonomy can simplify the complex tasks during minimally invasive surgeries for the surgeons. We developed a miniature parallel robot for minimally invasive laser guidance in laser osteotomy [1]. Fixing this miniature robot directly to cutting surfaces increases the robustness of the laser against mechanical disturbances and the accuracy of the laser position. However, developing an attachment concept for minimally invasive surgery is a challenge.


Miniature parallel robot for minimally invasive laser osteotomy


Gecko-inspired attachment strategies

Task description: The goal of this thesis project is to develop attachment mechanisms for the miniature robot to allow accurate laser cutting of tissue. Choices of the attachment strategies are still open.

Recommended work packages:

- Literature research: Literature research on state-of-the-art and theory of attachment strategies suitable for medical applications will be conducted.
- Concept development: Concepts of different attachment strategies suitable for integration into the miniature robot for minimally invasive laser osteotomy will be developed. The concepts will be evaluated with respect to the requirements present during minimally invasive laser osteotomy in the knee.
- Prototype development and control implementation: Prototypes of the most promising attachment mechanisms will be developed. Control strategies required for the attachment of the miniature robot will be implemented.
- Evaluation: Functionality of the prototypes and the control strategy will be shown. The performance of the concepts will be evaluated with respect to the defined requirements.

References

[1] M. Eugster, J.-P. Merlet, N. Gerig, P. C. Cattin, and G. Rauter, "Miniature parallel robot with submillimeter positioning accuracy for minimally invasive laser osteotomy," *Robotica*, pp. 1–28, 2021.

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Duration: 6 months

Supervision:
Yukiko Tomooka
Dr. Manuela Eugster
Prof. Dr. Georg Rauter

Contact:
Yukiko Tomooka (yukiko.tomooka@unibas.ch)
+41 61 207 54 66
https://biromed.dbe.unibas.ch