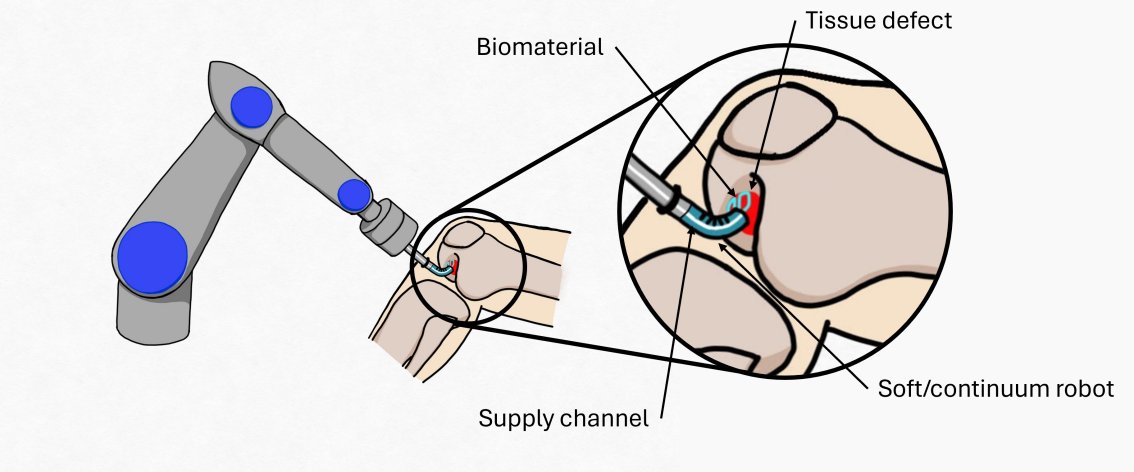
University of Basel
Department of Biomedical Engineering

BIROMED-Lab
Medical Robotics and Mechatronics

Bachelor Thesis:
Development of a continuum robot for endoscopic in situ 3D bioprinting

Context: 3D bioprinting has traditionally focused on the manufacturing of bio-engineered scaffolds *in vitro* and subsequent implantation to promote the regeneration of damaged tissues. One such application of this technology is for the restoration of osteochondral defects on the knee, which cannot heal by themselves due to the reduced vascularization of the tissue, among other factors. *In situ* or *in vivo* bioprinting, on the contrary, proposes the deposition of materials directly at the site of the defect. In doing so, the risk of contamination of the implant is reduced, and its conformity with the defect size is maximized. Further benefits are envisioned when adopting an endoscopic or minimally-invasive approach, such as faster healing and reduced damage to surrounding tissues. However, this comes with multiple technological challenges. For example, studies have observed that, when printing on non-planar surfaces, interactions between the nozzle and the material can lead to deviations in the shape of the implant from the planned ones. Rather than printing through a rigid needle, an actuated endoscope-like system can allow the dispensing of material perpendicularly to non-planar surfaces, improving the quality of the construct, and preserving the benefits of a minimally-invasive approach. Due to the small form factors required, the use of continuum or soft robots is envisioned as a potential solution to this problem.



Task description: To develop a first functioning prototype of a flexible endoscope with a supply channel for the material dispensing tube.

Workpackages:

- Perform your own small literature review for existing approaches, requirements, and used materials for endoscopic soft robots.
- Develop, design, and compare early concepts or solutions for the "soft printing robot".
- Manufacture and assemble a working prototype.
- Evaluate the prototype.

Student: Calvin Rüegg
Start: March 2024
Duration: 17 weeks

https://biromed.dbe.unibas.ch

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