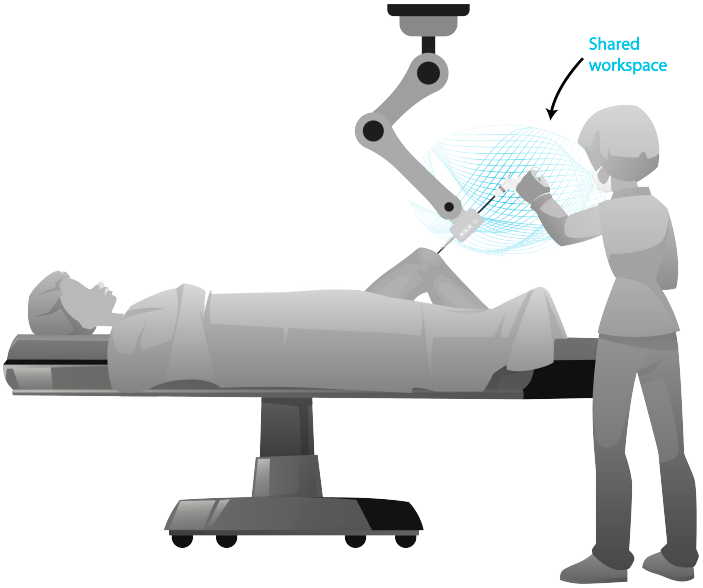
University of Basel
Department of Biomedical Engineering

BIROMED-Lab
Medical Robotics and Mechatronics

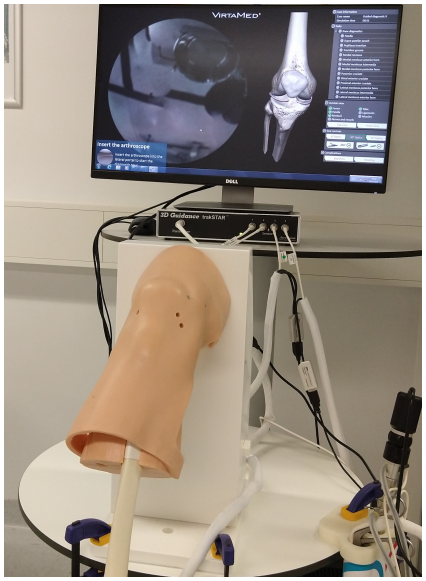
Master/Semester Thesis: Quantitative evaluation of shared surgeon-robot workspace for robot assisted knee surgeries

Context: At the BIROMED-Lab we build robots that can assist surgeons. We develop intuitive control methods that allow surgeons to directly interact with the robot (Figure 1a). Presently, we use a KUKA LBR iiwa as the macro-robot that can hold any tool for a surgical procedure. The choice of tool mounting position and orientation at the end of the robot affects the robot's useful workspace. The main goal for this project would be to identify the workspace requirements for a robot assisted knee arthroscopy.

Task description: Your task would be to design an experimental setup and evaluate the shared workspace in a simulated knee arthroscopy. You would use a knee simulator setup (Figure 1b) and conduct simulations by medical experts while tracking the tool pose (position and orientation). The recorded pose data is then analyzed to estimate the workspace requirements for such a surgical procedure.



(a)



(b)

Figure 1: (a) Concept of robot assisted knee surgery. The blue lines represent the 6-DoF shared workspace (position and orientation of the endoscope) required for a surgical procedure. (b) Knee simulator setup (VirtaMed AG, Switzerland) at the BIROMED-Lab to be used to estimate the shared workspace.

Workpackages:

1. Survey literature to identify related work where workspace requirements for surgical robots are estimated.
2. Build the experimental setup with the knee simulator and tool tracker.
3. Design the experimental protocol and conduct user study with medical experts.
4. Analyze the pose data to estimate and visualize the workspace requirements.
5. Evaluate the feasibility of using existing robots for the surgical procedure.

Benefits:

1. Gain experience in designing and conducting experiments with users.
2. Experience working with surgical simulator.
3. Work in an open-minded and friendly team in an academic environment.

Student:
Start: April 2022
Duration: 6 months
https://biromed.dbe.unibas.ch

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