



Master Thesis: Intuitive surgeon robot interface to control macro-robots and exchange surgical tools

Context: Macro-robots are used to position tools that are used during the surgery. We are using a KUKA LBR iiwa as a macro-robot in the flagship project MIRACLE (Minimally Invasive Robot Assisted Computer-guided LaserosteotomE). To make the robot control intuitive, we are developing different user control modes for the surgeon to interact with the robot [1].

Task description: Your primary task will be to design and develop an intuitive *user interface* for surgeons to control the robot hands-on. Such an interface would be mounted on the robot and take input from the surgeons to move the robot in the task-, joint-, or null space as desired. Your secondary task is to design a *tool holder* that allows attaching and quickly exchanging different tools used during the surgery.



Figure 1: Current macro-robot setup that uses a commercial KUKA LBR iiwa robot on a linear axis.

Workpackages:

- 1. Survey literature for existing user interfaces and tool holders (industrial and surgical robots).
- 2. Formulate the surgical workflow in a representative robotic surgery, and identify the requirements for *user interface* and *tool holder*.
- 3. Design and manufacture prototypes of the user interface and tool holder.
- 4. Integrate the prorotypes in robot control and demonstrate its working in a mock-up surgical setting.
- 5. If the prototypes satisfy the requirements, evaluate its utility with a user study.
- [1] Riccardo Parini. Reducing time and surgeon mental workload for robot positioning in operating room using learned desired null-space joint configurations. Master's thesis, University of Basel and Politecnico di Milano, Switzerland and Italy, 2019.

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