Real-time control of an articulated robotic arm using a virtual reality system

The Institute of Medical Device Technology (IMT) is investigating the possibilities of robotic assistance during laparoscopic surgery. An articulated robotic arm with 7 degrees of freedom is used to perform complex movements and tasks with high accuracy. The aim is to control this articulated robotic arm via an intuitive input device mimicking the user’s actions with a low latency using a Master-Slave-Setup.

Using an HTC Vive VR-System and its controllers, a tele-operated setup with the robotic arm should be designed. To be able to perform high accuracy tasks with the robotic end effector, a movement scaling must be implemented. Thus, a user can perform larger and free movements while the robotic end effector executes them in a precise way to perform tasks in a millimeter range. Part of this thesis is to also implement a camera (or the VR-headset) to provide imaging in the same scale than the movements are. It then has to be investigated which scaling is best for the performance of high accuracy tasks. Therefore, a study with individuals must be designed and assessed.

The main points to be addressed are:
- Improvement of the low latency controller and implementation of restrictions in the movement space of the robotic arm
- Test and characterization of the system regarding dynamics, latency, stiffness and accuracy
- Implementation of a VR-controller (and headset)
- Design of experiments to investigate the best scaling of movements
- Comparison of the usability with conventional input devices

Requirements:
- good knowledge in C++
- interest in Steam OpenVR SDK
- good knowledge in control engineering
- motivation to work independently

Supervision will be provided in English and German. The Thesis should be written in English.

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