Open Master Thesis Project

BIROMED-Lab

Department of Biomedical Engineering

Project background:

You will join the BIROMED-Lab at the University of Basel, which performs medical and rehabilitation robotics research under the lead of Prof. Dr. Georg Rauter. As part of the **FLOAT** team, you will work on improving the transparency and control of the robot, making it more intuitive in different rehabilitation scenarios for both patients and therapists.

Project description: Digital Twin for a Cable-Driven Parallel Robot, the FLOAT

Digital twins of CDPRs in physics engines are scarce in the literature, and existing ones either omit rigorous hardware validation or simplify cables to massless springs. No hardware-validated digital twin of a room-scale rehabilitation CDPR has been reported.

This thesis addresses that gap in two parts: (i) defining an open-loop validation protocol tailored to FLOAT, possibly generalisable to CDPRs; and (ii) applying it to a digital twin of FLOAT to produce a quantified characterization against measured hardware signals.

The work is structured into the following tasks:

- Define the open-loop validation protocol for the FLOAT.
- Record relevant FLOAT signals and introduce suitable excitation conditions where necessary.
- Develop a digital twin of the FLOAT and implement it in a physics engine, with analytically computed cable forces applied as external wrenches.
- Apply the validation protocol and report the agreed-upon performance metrics and workspace-dependent fidelity bounds.

Your profile:

We are looking for a candidate with the following background:

- Proficiency in Python, C++, MATLAB.
- Solid understanding of rigid-body dynamics / mechanics and linear algebra.
- Working knowledge of ROS2.
- Interest in physics simulation, robotics, and rehabilitation technology.

Software and tools you might work with: MuJoCo, NVIDIA Isaac Sim / Isaac Lab, ROS2, Python, MATLAB, TwinCAT, Qualisys, Git.

Start Date: As soon as possible.

Ready to advance rehabilitation robotics? We are.

Apply for this project by email sending us the following materials:

- CV
- Diplomas and course transcripts

Want to know more about us? check out www.dbe.biromed.unibas.ch and contact us for a lab visit.

University of Basel

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