F26.32 Open-sourcing robotic rehabilitation

Overview

Physical therapy to restore upper-extremity motor function after neuromuscular disorders, such as stroke and spinal cord injury, is labor- and cost-intensive. Robotic exercises were developed about three decades ago to reduce the therapy cost and increase exercise effectiveness by freeing up therapists' time and allowing higher therapy doses. However, the high cost of such robotic systems (usually >$100K per robot) has hindered their widespread adoption in healthcare systems. The goal of this research is to make robotic rehabilitation more accessible by developing an open-source library of robotic exercises that can be implemented on a variety of hardware platforms. This project parallels recent paradigm shifts in robotics, where open-source and hardware-agnostic algorithms led to explosive growth in robotics, both in research and commercial spaces.

The main activity in this project involves collecting human movement data using optical motion capture and custom-made force-sensing apparatus during therapy sessions. The intern will record patient-therapist interactions during various therapeutic exercises. If time is available, the intern will also analyze the data using modern machine learning methods, and transfer that information to the robotic domain to build an open-source library of exercises that can be implemented on various robotic hardware.

What the student will DO and LEARN

The intern will work with a graduate student in mechanical engineering and a physical therapist to collect movement data as the therapist interacts with a patient during therapeutic exercise. The intern will learn to work with an optical motion capture system to collect human movement data. The intern will also design and build instrumented fixtures that can subsequently be used to transfer movements to the robotic platform. The intern will design and manufacture these instrumented fixtures using 3D printing methods and will integrate microcontrollers and force sensors to collect patient-therapist interaction force.

Additional benefits

The intern will have full experience in an active research group, from generating ideas to laying out steps for carrying out the research, to writing articles and presenting the work (if they wish to continue beyond this I2S project). The intern will be treated in my lab as a researcher whose ideas are valued. By working in the interdisciplinary lab, the intern will also gain practical knowledge about robotic arms, their types, capabilities, and how they can be used in rehabilitation engineering.

Additional qualifications

Computer-aided design (e.g., Solidworks). Mechatronics system (Arduino, sensors).

Time commitment

6 hrs/week for 30 weeks