Augmented Reality (AR) based virtual prosthetic training system

Background: The most high-profile aspects of upper-limb prosthetic research focus on the development of control systems that allow patients to access greater functionality with their limbs, and research conducted in the sensory feedback realm to provide users the ability to feel with their mechanical limbs. Although cutting-edge technologies have become commercially available, clinical experience is that the patients need to familiarize themselves with these novel technologies before they begin to use them. The over-arching goal of training is to train and truly help amputees in their activities of daily living.

Current advances in artificial reality provide a strong foundation for creating a virtual system that allows patients to try their control capabilities with a virtual prosthetic arm and to practice and train with the system before they receive their physical prosthesis. This in turn will allow users to reach their full potential during everyday use.

Goal of the project: This project is driven by a strong clinical need to create an immersive assessment and training tool for amputees and clinicians. The initial goal is to create a virtual arm in the Unity environment and use the combination of IMUs (Inertial Measurement Unit) and EMG electrode data to model the movements of the virtual arm in augmented reality space according to the user's intent. The platform for the system will use the Microsoft HoloLens and firstly able-bodied subjects and later the amputees will be trained and tested in the AR-based prosthesis training system.

Benefits to the student: The opportunity to get hands on experience in the development of cutting-edge augmented reality applications, conducting experiments with human subjects in the relevant patient population, and the potential for journal publication. We have sought funding for this project, and will be jointly carried out with collaborators at Physical Medicine and Rehabilitation department at School of Medicine and Infinite Biomedical Technologies, giving the student startup/small company collaboration and translational research experience.

Skills/Experience:

- *Advanced skills in Unity programming environment:* previous work on the project was completed in Unity and therefore students involved in the project will need to learn and become comfortable working in this environment. The student will be encouraged to take relevant courses in computer science/engineering to build up the state of the art skills.
- *Basic experience in instrumentation:* the student should have a fundamental understanding in circuitry design.
- *Intermediate coding skills in Matlab and/or Python:* interfacing the IMU and EMG sensors with the virtual environment is done through Matlab a Python software components. Modifying, debugging and using these components requires a fundamental understanding of the programming languages. The student must have prior experience coding in both Matlab and Python with experience beyond class assignments with at least one.
- *Self-motivation and the ability to conduct independent work:* The student should take the take suitable courses, acquire relevant skills, and then implement realistic, 'real-time' prosthesis environments, and test them in augmented reality and then on amputees. New ideas and independent work are highly encouraged and valued in the lab.

Expectations: Motivation to translate the technology for amputee needs. Publication and/or patenting of the original work is a must.