Robotics for gait assistance and rehabilitation

Sangjoon Kim
Department of Mechanical and Aerospace Engineering
University of California, Irvine

Friday, October 21, 2022 – 10:30 am
McDonnell Douglas Engineering Auditorium (MDEA)

Abstract: The number of patients with gait-related impairment has been steadily increasing with global aging. To address these issues, many research topics have been directed toward developing robotic technologies for gait assistance and rehabilitation. For the first half of the talk, a fully portable pneumatic AFO system used to assist drop-foot patients will be presented. For wearable robotic applications, pneumatic transmission has many advantages in 1) minimizing the end-effector mass and system complexity due to the flexibility in placing pneumatic components and 2) providing high back-drivability (i.e., low resistance) via simple valve control. However, pneumatic systems are generally tethered to large stationary air compressors, which greatly limits their practical daily usage. The speaker will introduce the development of a miniature custom air compressor and the implementation of a fully portable unilateral pneumatic AFO system to assist the dorsiflexion (DF) motion of drop-foot patients. For the second half of the talk, the speaker will introduce a pragmatic device, called “Boost”, for wheelchair ambulation and arm exercise after stroke. Boost allows stroke patients to have ready access to highly effective therapy in a way that integrates seamlessly with routine clinical practice.

Bio: Sangjoon J. Kim is currently a postdoctoral researcher in the Department of Mechanical and Aerospace Engineering at the University of California Irvine and a research engineer at Flint Rehab. He received his B.S. degree in electrical engineering from the University of Wisconsin-Madison and his M.S. and Ph.D. degrees in mechanical engineering from Korea Advanced Institute of Science and Technology (KAIST). He carried out his first postdoctoral studies at Shirley Ryan AbilityLab (formerly Rehabilitation Institute of Chicago) developing methods to enhance lower-limb motor learning and wearable robotic control strategies using EMG signals. His research interests include wearable robotic technologies, neurorehabilitation, and robotic control.
Investigation of neuromotor control of the wrist using an fMRI-compatible robot

Andria Farrens
Department of Mechanical and Aerospace Engineering
University of California, Irvine

Friday, October 21, 2022 – 10:30 am
McDonnell Douglas Engineering Auditorium (MDEA)

Abstract: Neurorehabilitation is centered on the idea that retraining motor function can be advanced by incorporating concepts of neuromotor control into therapy. Robot-mediated neurorehabilitation (RMN) uses robots as tools to execute rehabilitation protocols to retrain motor control following neural injury. Although many everyday manipulation tasks are performed using the hand and wrist, relatively few studies have focused on the neuromotor control of the wrist, especially during human-robot interaction. To address this gap, we used an fMRI-compatible wrist robot to study neuromotor control of the wrist during neuroimaging (fMRI). In this talk, I will cover work performed to establish the behavioral characteristics of dynamic motor control of the wrist using this device, localization of brain regions engaged during task performance and changes in neural function following task performance reflective of consolidation of newly learned behaviors. By studying these processes in healthy individuals, we can better understand the fundamental relationships between motor training, motor learning and neuroplasticity.

Bio: Andria J. Farrens is a Mechanical Engineering postdoctoral researcher in the Biorobotics Lab at the University of California, Irvine. She received her B.S. in Mechanical Engineering, with a minor in Biomedical Engineering from the University of California-Davis, and her Ph.D. in Biomedical Engineering from University of Delaware, Newark. In her thesis research, she studied neuromotor control of the wrist in healthy and post-stroke individuals, using an fMRI-compatible robot and computational modeling. Her research interests include neurorehabilitation, rehabilitation robotics, and neuromotor control.