Simulation of Abnormal Crouch Gait and Development of a Generalized Torque-Additive Rehabilitative Technique for Complex Mobility Issues

Shen, Allen (School: Clear Lake High School)

Crouch gait is a complex pattern of movement that affects 150,000 children with conditions such as cerebral palsy, spina bifida, or spinal cord injuries. Crouch gait severely limits mobility and contributes to muscle degeneration, and will jeopardize walking ability. It is vital to rehabilitate crouch gaits in a time-sensitive, cost-effective, structured technique. While crouch gait is a niche movement pattern, my project hopes to generalize this technique to a wider variety of conditions. Thus, my project aims to: 1. reliably simulate complex gait conditions given various parameters, 2. develop and formalize a technique to individualize additive treatment using said simulation, and 3. validate results using an exoskeleton In order to complete this project, I used OpenSim. In association, I used packages with Notepad++, MatLab, Java/Python packages, and CAD files. I imported a widely-available musculoskeletal model from online. Then, I tailored it to the parameters of several children with crouch gait by scaling through an XML file. I continued by writing the XML files and associated marker for movement to simulate motion. I examined the results from my simulation, and identified which areas needed supplementary torque and which needed complementary torque. Then, I juxtaposed the graphs to determine necessary forces to rehabilitate a gait. Lastly, I compared feasibility with a pediatric exoskeleton. This is a technique that can be generalized to all complex gait cases and supplementary strength. My data determined that my simulation was highly accurate. For my rehabilitative technique, 95% of the parameters that I found were consistent with the exoskeleton's capabilities.