Technologies for the Assessment and Care of Children with Cerebral Palsy

Gerald F. Harris, Ph.D., P.E.

This presentation will discuss current research and development based on innovative technologies that address the needs of children with Cerebral Palsy and orthopaedic disabilities. The work is designed to offer new tools, better technologies, and improved evidence-based treatment strategies.

An overview will be presented of available technologies used to assess mobility and assist with therapy in a clinical setting. The equipment will primarily be involved with the assessment and assistance for joint range of motion, strength, gait, posture and ability to perform activities of daily living. Technologies uses to assist in therapy will include mobility assistance, interactive gaming, biofeedback, functional electrical stimulation and virtual reality.

Technologies supporting the assessment of lower extremity demands during ambulation provide a recognized basis for pre-treatment assessment and post-treatment follow-up of children with cerebral palsy and other orthopaedic disabilities. These technologies also form the basis for development of customized models specifically tailored to these populations. Examples of recent specialized models to examine planovalgus and equinovarus foot deformities in children will be presented.

Recent developments in fluoroscopic application for the assessment of in vivo hindfoot motion during locomotion will be presented. System evaluation against bone pin studies will be discussed along with a presentation of fluoroscopic motion data (shod and unshod). Design methods used to advance the technology for 3D assessment of bony motion will be discussed.

Technologies supporting efforts to gain more knowledge about internal joint demands of the upper extremities during assisted ambulation and wheelchair propulsion will be discussed. Current and evolving methods and models will be presented that focus on efforts to determine the relationship between joint forces, assistive device and wheeled mobility use. Further methods that utilize this information to support tissue level investigations will also be described.
**Robotic technology** for assisted movement therapy can be a useful adjunct to the clinician by offering treatment strategies that are innovative and attractive to patients, yet responsive to therapeutic demands. A robotic approach to ankle impairment in children with cerebral palsy is presented which offers controlled passive stretching combined with active (motivating) movement training. Applications of the technology within the clinic and home environments are addressed.

Recent work with **advanced imaging technologies** and modeling techniques will be described with application examples. An fMRI imaging approach to detect changes in brain plasticity associated with hamstrings lengthening will be described. An approach to characterization of bone material properties in children with osteogenesis imperfecta will be described which employs synchrotron micro-CT imaging and finite element modeling.