Next generation soft wearable robots

Next generation wearable robots will use soft materials such as textiles and elastomers to provide a more conformal, unobtrusive and compliant means to interface to the human body. These robots will augment the capabilities of healthy individuals (e.g. improved walking efficiency) in addition to assisting patients who suffer from physical or neurological disorders. This talk will focus on a soft exosuit that can apply assistive joint torques to synergistically propel the wearer forward and provide support to minimize loading on the musculoskeletal system. The exosuit consists of a cable-actuated multi-articular textile that interfaces to the wearer at the pelvis, leg and foot. The architecture of the suit is such that it mimics the underlying function of the muscles at the hip and ankle and generates forces through a combination of passive and active tensioning. The exosuit does not contain any rigid elements supporting compressive loads, so the wearer's bone structure must sustain all the compressive forces normally encountered by the body plus the forces generated by the suit. Unlike traditional exoskeletons which contain rigid framing elements, the soft exosuit is worn like clothing, yet can generate significant moments at the ankle and hip to assist with walking. Future versions of the exosuit will monitor the 3D kinematics and kinetics of the wearer using soft stretchable sensors that do not interfere with the natural mechanics of motion. Advantages of the suit over traditional exoskeletons are that the wearer's joints are unconstrained by external rigid structures, and the worn part of the suit is extremely light, which minimizes the suit's unintentional interference with the body's natural biomechanics. Previous research studies on human-robot interaction and biomechanics have largely been performed with rigid exoskeletons that add significant inertia to the lower extremities and provide constraints to the wearer's natural kinematics in both actuated and non-actuated degrees of freedom. Actuated lightweight soft exosuits minimize these effects and provide a unique opportunity to study human-robot interaction in wearable systems without affecting the subjects underlying natural dynamics.

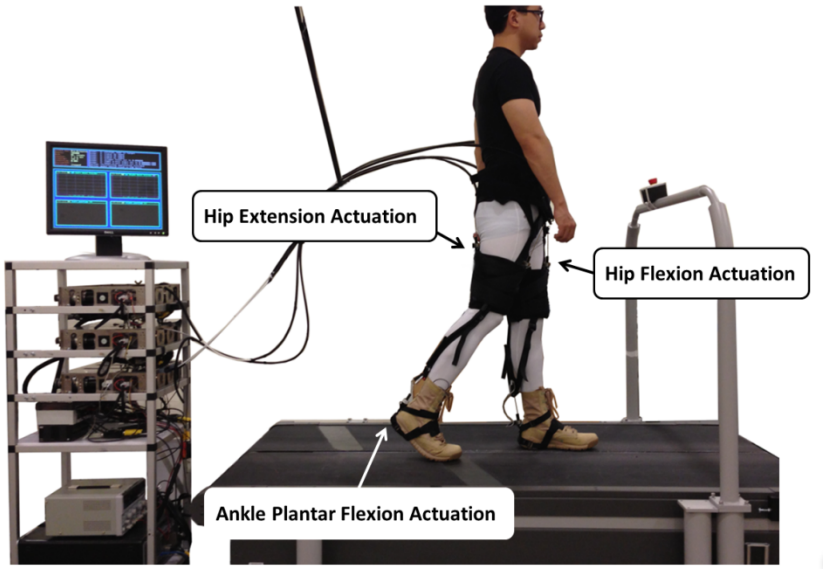


Figure: Human-robot interaction experiment with a soft exosuit tethered to a multi-joint actuation platform