Overcoming key barriers to workplace integration: the science, design and evaluation of spring--powered exosuits for lifting, leaning and locomotion

This presentation will summarize research and development progress on a class of unmotorized, spring--powered exosuits (mechanized clothing) that are lightweight, lowprofile, unobtrusive, quiet and can fit comfortably under daily clothing. Our goal is to overcome several key barriers to workplace integration and to widespread adoption of exoskeletons in industry and society. We seek to develop inconspicuous devices that: (i) fit and feel like everyday clothing, allowing unrestricted range of motion without components protruding out from the body, and (ii) can be engaged on-demand, using clutchable fabric springs to physically augment human performance. We will describe the science underlying these unmotorized exosuits: biomechanically how they reduce musculoskeletal loading, and their potential to reduce overuse/overexertion injury risks. We will discuss updated designs for various parts of the body (e.g., back, ankle) and various activities (e.g., lifting, leaning, locomotion), then share new experimental results showing how prototypes have reduced muscle loading and fatigue. We will also discuss user-specific muscle adaptation patterns, which may have important implications for the development of exoskeleton evaluation standards in industry, and how wearable sensors are being integrated to further enhance worker safety and productivity.

Bio

Dr. Zelik codirects the Center for Rehabilitation Engineering & Assistive Technology (CREATE) at Vanderbilt University. CREATE aims to improve health, mobility and independence for individuals with disabilities, and to enhance human capabilities beyond biological limits, by engineering, measuring, optimizing and understanding technologies that physically augment human performance. Dr. Zelik's research team employs experimental and computational methods to study human biomechanics and how biomechanical principles can translate into improvements in assistive devices (prostheses, exoskeletons, smart clothing). Dr. Zelik received his B.S. and M.S. in Biomedical Engineering from Washington University in St. Louis, then his Ph.D. in Mechanical Engineering from the University of Michigan. Following this, Dr. Zelik was a postdoctoral researcher and Whitaker International Scholar at the Santa Lucia Foundation Rehabilitation Hospital in Rome, Italy. He joined the Mechanical Engineering faculty at Vanderbilt University in 2014, and holds secondary appointments in the departments of Biomedical Engineering and Physical Medicine & Rehabilitation.