

Building the Future of Prosthetics and Wearable Robotics

Over the past several decades, the development and commercialization of powered prosthetic limbs have advanced rapidly. These bionic devices can provide controlled power, enabling individuals to perform daily activities that might otherwise be challenging or impossible. However, identifying optimal methods to control these devices remains an open area of research, and effective control is critical for achieving reliable behavior and functionality. Moreover, various issues contribute to high abandonment rates among prosthesis users. For instance, current prosthetic arm controllers can cause compensatory movements, leading to shoulder and back pain, while most above-knee (AK) amputees experience elevated metabolic costs when walking, potentially reducing their mobility and quality of life. In this talk, I will discuss how we are integrating robotics and human motor control insights to address these and other challenges, with the goal of developing more advanced prostheses and control systems. Specifically, I will present our work on machine vision and artificial intelligence, which aims to enable more deliberate and context-aware intent prediction, making prostheses more reliable and accurate. Additionally, I will cover our development of semi- and shared-autonomous control frameworks based on naturalistic movements, designed to reduce cognitive load and user control effort, making prosthesis use more intuitive. Finally, I will highlight our recent research on the relationship between kinematic miscoordination, energetics, and the increased metabolic demands on AK amputees, which can help ensure we provide the appropriate level of assistance that can reduce user exertion. By combining robotics advancements with insights from human motor control, we aim to create prosthetic systems that offer a more intuitive, effective, and accessible experience for users.

Dr. Nili Krausz is an assistant professor in the Faculty of Mechanical Engineering at the Technion - Israel Institute of Technology, where she holds the Brenda and Russell L. Frank Endowed Faculty Fellowship. She is the Director of the Neurobotics and Bionic Limbs Lab (www.enabletechnion.com) and a recent recipient of the Israel Higher Education Council Fellowship for Outstanding Young Faculty. Dr. Krausz completed her Ph.D. in Biomedical Engineering at Northwestern University and the Shirley Ryan AbilityLab under Dr. Levi Hargrove, following an MS in Mechanical Engineering from the University of Colorado Denver with Dr. Richard F. Weir. She also served as a postdoctoral researcher at the Weizmann Institute of Science with Dr. Tamar Flash and was a visiting researcher at the École Polytechnique Fédérale de Lausanne (EPFL) with Dr. Aude Billard and Dr. Silvestro Micera. Her research focuses on developing improved assistive and rehabilitation robotics to enhance quality of life for those with physical disabilities and using robotics and engineering models to better understand mechanisms and the altered motor behavior of individuals with neural-motor pathologies.

