



## MECHANICAL ENGINEERING SEMINAR

Monday, April 21, 2025 at 14:30, Dan-Kahn Building, Room 217

### The Role of Computer Simulations in Optimization Exoskeletons

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Host: Assoc. Prof. Yizhar Or

The design of exoskeletons poses a complex challenge that goes beyond traditional robotic systems, as the interaction between humans and exoskeletons must be taken into account. In contrast to controlled robots, exoskeletons must be seamlessly integrated into the human musculoskeletal system, which requires appropriate control strategies and an understanding of human motion dynamics. In this talk, I will review the three main methods for developing exoskeletons: 1) Test and rebuild, 2) Human in the loop, and 3) simulation. I will mainly focus on simulation, which includes models of both the electromechanical system and the biomechanics of the human user. The advantages and limitations of the simulation method will be demonstrated using several exoskeletons that we have built in our lab: (1) biomechanical energy harvester, designed to produce electricity without increasing the user's effort; (2) exoskeleton for vertical jumping that allows explosive movements at high speed, unlike most exoskeletons that are designed for continuous use in aerobic tasks (e.g., walking, running, lifting). Thus, we have developed the first exoskeleton that increases the user's jumping height and investigated the interactions between humans and exoskeletons. While traditional simulation uses experimental trajectories without the actual exoskeletons, we have developed a simulation for jumping exoskeletons that enables motion adaptation for improved utilization. We also compared the simulation results with experimental data using an actual exoskeleton. This framework was extended to also create a simulation for a running exoskeleton. The results of our studies reveal similarities and important discrepancies between experiments and simulations and shed light on the limitations of current modeling techniques.

**Short bio:** Raziel Riemer is an Associate Professor at the Department of Industrial Engineering and Management at Ben-Gurion University of the Negev. He holds a B.Sc. in Mechanical Engineering and an M.Sc. in Industrial Engineering, both from Ben-Gurion University of the Negev, and a Ph.D. in Mechanical and Industrial Engineering from the University of Illinois at Urbana-Champaign, USA. His research interests are in the areas of human motion analysis, modelling and simulation and wearable robotics. Prior to his academic career, Raziel worked in industry for six years as a mechanical and industrial engineer, primarily at Intel. In the distant past, he was a competitive swimmer (Israel champion and record holder) and enjoys using his knowledge of biomechanics to improve the performance of athletes.

\*The lecture will be given in English.