**MECHANICAL ENGINEERING STUDENT SEMINAR**

**Thursday, August 25 2022 at 13:00**, **Online:** <https://technion.zoom.us/j/95617217499>

**A Biomechanical System for Automatic Patient-Specific**

**Foot Ground Reaction Force Regulation-**

**Based on Finite Element Analysis**

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Lower-limb diseases, such as degenerative diseases of the joints (e.g., osteoarthritis), or foot problems such as foot infections and diabetic foot ulcers, are very common and significantly affect the ability to undertake day-to-day activities. These diseases create unusual external and internal loads that deviate substantially from the normal making the ability to carefully manipulate foot loads a key factor when treating symptoms of these diseases. Diabetic foot ulceration is among the most common, serious, and destructive complications of diabetes throughout the world. Over the course of their disease, 25% of people with diabetes will develop a foot ulcer, the leading cause of ultimate lower extremity amputation, especially when wound infection or osteomyelitis are involved. The aims of my Ph.D. research are to first develop a robotic footwear device for efficient treatment of lower-limb and foot pathologies by means of autonomous objective external loads manipulation. The second aim is to develop a patient-specific approach for optimal foot pressure distribution for preventing and treating diabetic foot ulcers.

The robotic footwear system is a shoe-like device enabling an accurate dynamic fit of the foot loads and center of pressure (COP). It consists of two adjustable convex-shaped biomechanical elements, attached to the bottom part of the device. Each element position can be adjusted individually with two degrees of freedom, shifting the COP in the respective direction. The robotic shoe is also equipped with embedded pressure sensors insoles enable continuous monitoring of the foot COP and external loads while the patient is walking. The main novelty of the device is its ability to dynamically change the COP and foot loads during gait, by using the pressure sensors insoles as closed-loop feedback control.

Secondly, using computational modeling and experimental methods, we developed a novel “graded-stiffness” offloading solution, that is, footwear support with concentric rings with gradually increasing material stiffness, which are made to be the softest at the innermost circle under the tissues at risk for ulceration, and to become stiffer farther away. Our method enables to form an adaptable and flexible system that can be customized to a specific patient, to fit the shape and size of the ulcer. This solution can be made as an off-the-shelf product or alternatively, be manufactured on-demand using 3D printing tools. The proposed novel practical offloading solution has the potential for streamlining and optimizing the prevention and treatment of diabetic foot ulcers.

Note: the seminar will be given in Hebrew