# DEPARTMENT OF MECHANICAL ENGINEERING

## SPECIAL SEMINAR

***to be held on Tuesday, June 18, 13:00***

*in the Seminar Room (#117) of the Mechanical Engineering Building (#55)*
*at the Campus of the Ben-Gurion University of the Negev*

# Mechanical aspects of fibrous networks embedded with contractile cells

**Dr. Ayelet Lesman**

*School of Mechanical Engineering, Faculty of Engineering,*
*Tel-Aviv University*

## Abstract:

The forces generated by cells are essential in many biological processes, ranging from cell migration to tissue formation. These cellular contractile forces are applied against the fibrous extracellular matrix (ECM) that exhibits complex 3D mesh structure and nonlinear elastic behaviour. Characterizing the response of the ECM to forces is important for understanding many physiological and pathological processes at the cell and tissue level.

In this talk, I will describe our biological experiments and computational modeling in order to understand how cell-induced deformations propagate, decay and distribute throughout the ECM. In our biologcial experiments, the cells (fibroblasts) gradually deform the matrix around them while creating bands of increased fiber density and alignment between each other. Such bands mechanically couple cells over long distances and at a large scale; the manner in which such bands are formed over time, their mechanical properties and the possible effect on cell's biological activity are analyzed.

Using finite element simulations, we learn that the long-range tranmission of forces is facilitated by the nonlinear elastic behaviour of the matrix. We quantify the contribution of three mechanisms - fiber alignment, fiber stiffening and fiber buckling, to slowing down the decay of displacements. We conclude that all three mechanisms contribute to a more general phenomenon – strain-induced elastic anisotropy, which is the key property controlling the decay of displacements.

Finally, I will suggest a novel mechanism of mechano-biochemical feedback in the regulation of long-range cell-cell communication. Using simualtion of random walk on a 3D lattice, we learn that fiber densification and alignment, formed by cell-induced forces, can lead to improve transport of molecules traveling between the cells.

Our results highlight the contribution of ECM deformations in supporting long-range and highly directional forces transmitted between contractile cells. This can ultimately allow distant cells to mechanically and biochemically communicate over long distances.

**Bio:** Ayelet did her PhD in Biomedical Engineering at the Technion in the field of Tissue Engineering. She then conducted post-doctoral studies at Caltech, focusing on cell mechanics. In 2016, she joined the School of Mechanical Engineering at Tel-Aviv University where she is heading a lab on the Biomechanics of Cells and Tissues.