MECHANICAL ENGINEERING STUDENT SEMINAR

Wednesday, November 13 2024 at 13:30, D. Dan and Betty Kahn Building, Room 217.
Online: https://technion.zoom.us/j/91606730111

The role of mechanical communication between cardiac cells in myocardial conduction wave

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Every heartbeat is initiated by an action potential (AP) that originates in the sinoatrial node and travels through the heart. It triggers a subsequent calcium release from the sarcoplasmic reticulum, initiating contraction of the cardiac cell. The electrical, calcium and mechanical signals are coupled by feedback loops and can be conceptualized as a system of three coupled oscillators. Neighboring cardiac cells communicate both electrically and mechanically. Electrical coupling occurs via gap junctions, channels that allow diffusion of ions between adjacent cells. Cardiomyocytes communicate mechanically by responding to the mechanical deformations generated by their neighbors in the extracellular matrix (ECM).

Here, we use a 2D cardiac tissue model (a monolayer of aligned cardiomyocytes cultured on an elastic substrate) to study the role of mechanical communication between cells in maintenance of normal conduction wave in the heart.

Using TFM (traction force microscopy), we are able to measure the traction and strain fields generated by the beating cells and measure the mechanical coupling. We show that in the case of normal level of mechanical coupling, the AP propagates unidirectionally from the position of the electrode towards the far end of the monolayer, while weak mechanical coupling leads to the formation of spiral waves (i.e., reentrant arrhythmia) in the culture.

By manipulating the geometry of the cardiac tissue, we show that defects in tissue geometries change the conduction pattern. Mechanical coupling is shown to reduce the sensitivity to these defects.

Note: the seminar will be given in English

Seminars Coordinator: Assoc. Prof. Gal Shmuel.