4D spatio-temporal image analysis of biomechanical interactions as markers of metastatic potential

Zimin Institute Research Summary

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In metastasis, cancer cells break from the primary tumor, invade through the extracellular matrix (ECM) to eventually form distant metastases. The interaction of cancer cells with their microenvironment, specifically the mechanical interactions, have been considered potential functional markers for metastasis. However, previous studies failed to develop robust quantifications of cell-ECM interactions due to vast heterogeneity among single cells and among varying microenvironments.

In this work, we perform high-content dual-channel 3D live imaging of the cells and their embedding matrix and develop image analysis algorithms to directly measure, for the first time, fluctuations in cell activity (e.g., shape features), and in the matrix remodeling around cells (e.g., fiber density and orientation) to characterize cell-ECM and cell-cell interactions as markers of metastatic potential. As proof of principle, we analyze melanoma cells with known and varied metastatic potential. This proposal reflects unique collaboration between **Dr. Ayelet Lesman**, an expert in the field of cell biomechanics, and **Prof. Nahum Kiryati**, a seasoned image processing and analysis researcher. We envision that our combined efforts will enable diagnosis and drug screening based on cell-ECM interactions as markers for metastatic potential.