MS2I_12811

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Elastic Interactions of Biological Cells

Samuel Safran[(1)], Alice Nicolas[(2)], Ulrich Schwarz[(3)]

(1) *Weizmann Institute, Rehovot Israel*
(2) *CRPP, Bordeaux, France*
(3) *MPI Golm, Postdam, Germany*

Modifications of the elasticity of the cytoskeleton of biolgical cells are responsible for dramatic changes in cell shape. Adhering cells exert forces on their environment; experiments on micropatterned elastomer substrates showed that these forces are correlated with the size and orientation of adhesion regions. The adhesions act as mechanosensors that convert the mechanical forces within the cytoskeleton into biochemical signals that cause these adhesions to grow in response to external stress. Averaging the forces due to the adhesions shows that each cell can be modeled as a pair of oppositely directed elastic forces. We predict theoretically that the cells deform the medium and this gives rise to an effective interaction among the cells that can be either attractive or repulsive, depending on their orientations and the boundary conditions. Our theory for the physical origin of the mechanosensor action of focal adhesions, models the adhesion molecules as a grafted layer whose effective elastic modulus determines its response to cytoskeletal forces. The model may explain the observed force dependent anisotropy of the focal adhesions. [Experimental collaborators: B. Geiger, A. Bershadsky, N. Balaban]

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