Elastic response of soft materials to biological cells

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Current research at the interface of materials science and cell biology has shown that the regulation of cellular processes such as proliferation, differentiation and tissue development, is controlled by the mechanical properties and geometry of cells and the surfaces upon which they are plated. Our theoretical research is motivated by experiments on cell mechanics that quantify the active response of biological cells to mechanical stress or strain and show how these can determine cell morphology and function. To understand how substrate rigidity determines these characteristics, we have generalized the theory of elastic inclusions in solids to ”living” inclusions (cells) whose active nature results in the feedback of cellular forces that develop in response to matrix stresses. The approach is extended to treat the very non-linear elastic response of many biopolymers and we present a relatively simple solution to the problem of an active inclusion in a non-linear elastic medium.