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Cell stiffening and softening evoked by optical stress application

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The mechanical properties of living cells are largely determined by the cytoskeleton, a complex bio-polymer network consisting of filamentous actin, microtubules and intermediate filaments. Cell-mechanical properties are meant to be of great importance in all kinds of tissue development (e.g. cancer). Commonly described as viscoelastic material, cells should be time translation invariant (TTI) in there mechanical response to a transient stress.

As cells are continuously restructuring their cytoskeleton, time translation invariance does not need to be fulfilled. We investigated the mechanical reaction of single suspended cells to a transient stress by using the optical stretcher, an optical divergent dual beam trap. There was no time dependence found in their mechanical behavior, after application of a small stress. By increasing the transient stress over a certain point we observed the cells to strongly stiffen directly after stress application, followed by softening back to its original value and even further. Additionally we found the characteristic times describing this behavior to be cell type specific.