MEASUREMENT OF SYSTEM BIOMECHANICS USING OPTICAL MICROSCOPY AND MICROMANIPULATION

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KEY WORDS: fluorescence microscopy, 3D microscopy, biomechanics, calcium imaging

By combining optical imaging with the application of controlled mechanical stimuli it is possible to measure the mechanical properties of a range of biological systems from cells to organisms and tissues. Such measurements can provide new insights into a range of fundamental biological mechanisms and pathological processes.

We have developed an optical microscope system incorporating high resolution micromanipulation stages for simultaneous mechanical stimulation and imaging of live biological samples. By deconvolution of widefield fluorescence images and particle tracking of fluorescent microspheres we are able to determine the 3D displacement of the sample in response to uniaxial indentation (Fig. 1). The underlying mechanical properties are then inferred by comparing the measured sample response with that predicted from numerical models.

This system has been applied to study the biomechanics of the \textit{C.elegans} nematode. Correlating the biomechanical data with neuronal activity, imaged using genetically encoded calcium indicators, has allowed us to study the mechanism of mechanotransduction by which the organism senses touch.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{pre-post-indentation.png}
\caption{Cuticle of an adult \textit{C.elegans} specimen before (left) and after (right) indentation with a glass capillary}
\end{figure}