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Measuring Nanoscale Viscoelastic Parameters of Cells Directly from AFM Force-Displacement Curves

A new computational algorithm extracts accurate viscoelastic properties of soft materials like living cells and hydrogels directly from standard atomic force microscopy experiments without requiring modifications to existing equipment.

Force-displacement (FZ) curves are the most commonly used atomic force microscopy (AFM) mode to measure the local nanoscale elastic properties of soft materials such as living cells. A theoretical framework has been lacking that allows the post-processing of FZ data to extract their viscoelastic constitutive parameters. Approaches other than the standard FZ curves are usually used to obtain the viscoelastic properties of samples with AFM in both the time and frequency domains. These generally require modifications in the AFM apparatus and/or in the data acquisition protocol. Each approach has its own sets of measurement uncertainties.

Researchers at Purdue University have developed a computational algorithm for processing AFM experimental data. This new method extracts viscoelastic properties of soft samples, such as living cells and hydrogels, directly from standard AFM FZ experiments, creating a common platform for the analysis of cell elastic and viscoelastic properties with arbitrary linear constitutive relations. By bringing rigorous viscoelastic analysis within the reach of standard, automated AFM FZ curves, this method is expected to greatly enhance the wider use and adoption of AFM for living cells and soft biomaterials viscos-mechanics assays. For the AFM users, it provides an ability to easily and accurately assess viscoelastic properties of the samples without modifications of the AFM apparatus. This technology integrates into existing AFM software or a new software program could be created.

Advantages:

-One standard method for analysis of elastic and viscoelastic properties of living cells and hydrogels

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Category

Biotechnology & Life Sciences/Biomarker Discovery & Diagnostics
Materials Science & Nanotechnology/Materials Testing & Characterization Tools
Biotechnology & Life Sciences/Analytical & Diagnostic Instrumentation

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-Accurate

-Easy to use

-Integrates into existing AFM software

Potential Applications:

-Extract viscoelastic properties of benign and cancerous cell lines

-New software for AFM

TRL: 6

Intellectual Property:

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Keywords: Atomic Force Microscopy (AFM), Force-displacement (FZ) curves, viscoelastic properties, living cells, soft biomaterials, hydrogels, nanoscale elastic properties, computational algorithm, AFM software, viscos-mechanics assays