Esplanade Room 157: Sunday, February 22

9:30 AM – 11:00 AM
Bruker

AI Driven Advanced AFM Imaging and Analysis of Cellular and Tissue Samples: Innovations in Large-Area Mapping and Mechanobiology

Atomic Force Microscopy (AFM) enables nanoscale mapping of stiffness, adhesion, and viscoelasticity, critical for studying cells, tissues, and biomaterials. Yet, challenges such as sample roughness and limited lateral range restrict large-area mechanobiological imaging. We present an advanced AFM concept integrating **SmartMapping** with the newly developed **CellWizard™ Stage**, which coordinates AFM head motors and XYZ-piezo movement for automated, high-precision mapping over a 38 × 38 mm range. Its multi-compartment design accommodates multiple samples, enabling high-throughput, reproducible measurements without user intervention.

The **AI-guided optical segmentation** automatically identifies single cells or regions of interest and generates AFM scan lists, facilitating intelligent navigation and continuous imaging across wells or slides. This combination of SmartMapping and AI segmentation ensures seamless, large-area, and drift-free mechanical mapping.

Using this system, we compared Cytochalasin D–treated and control 3T3 fibroblasts, revealing time-lapse mechanical and structural changes. We further characterized 3D SKOV-3 spheroids, zebrafish tumors, and mouse brain tissue, correlating regional mechanical variations with structural organization.

Together, these advances establish a new paradigm for automated, intelligent, and large-scale AFM imaging, greatly enhancing throughput and precision in mechanobiology and expanding AFM's applicability to complex biological systems.

Speaker
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