NANOSCIENCE COLLOQUIUM

Biological motion as an encoder of biological identity, a single molecule and machine learning perspective

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ABSTRACT: Biological motion is important in all aspects of biological function: protein structural dynamics are central for protein function and biomolecular recognition; biomolecules' spatial and temporal localization enables their interaction and downstream processes initiation; signaling emergence is reliant on organelles motion, which is driven by specialized motors. Profound understanding of how motion underlies biological function, is crucial for controlling aberrant biological function and biomedicine but, is a formidable challenge as it remains masked in assays averaging the behavior of a large ensemble of unsynchronized molecules. My lab is approaching this challenge by devising advanced microscopic techniques for interrogating the interplays of spatial localization and function of individual protein and cellular compartments and how this relates to cellular outputs. To analyse the complex, multidimensional, multiterabyte data we acquire, we have developed novel methodologies based on machine learning that offer rapid precise and automated transition from raw microcopy images to quantitative biomedicine insights.

Here I will focus on our recent findings on
a) introducing the concept of biased metabolism, showcasing how structural dynamics encode fidelity of biomolecular recognition and how this allows us to design pathway-specific therapeutics suppressing undesired, disease-related, metabolic pathways
b) demonstrating the descriptive power of the diffusional behavior to encode identity and functionality of organelle, and how based on single particle tracking and machine learning approaches we can infer cellular entry events (virus nanocarriers) based exclusively on diffusional traits, paving the way for label free classification of cell organelles.

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