

Engineering approaches for single molecule sensing

עקרונות ביו-הנדסיים לחישה מולקולות בודדות

Updated Syllabus (336538) - January 2024

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To all students: in place of a new syllabus please see below a list of topics we will cover this year, and the Key Concept (or questions) you will learn in the course.

Topic	Key Questions and Concepts
Intro to Single Molecule Sensing. Motivation, and an overview of the course	Why should we care about single-molecule sensing? What are: Single molecule fluorescence sensing? Label-free sensing? How all this relates to super resolution microscopy?
Single Molecule Fluorescence	What's is the meaning of Brightness and QY? Fluorescence vs. scattering? What is TCSPC? What is Jablonski diagram? What makes this approach (still) the most sensitive optical method?
FRET Efficiency: The spectroscopic Ruler	What is energy transfer phenomenon? What is FRET and why FRET is called a "spectroscopic ruler"? What is the difference between FRET efficiency and Proximity factor? The Clegg and Lilley dsDNA model.
Single Molecule FRET	What are the key factors enabling single fluorophore sensing? Why is it so important? What is bursts analysis and who is Nico?
Nanopores: Single molecule, without the labels. How is it possible?	What are the driving forces behind Electrophoresis? Why do DNA molecules migrate with same speed independently on their size? What is the source for the name alpha Hemolysin? Using nanopores to learn about RNA structures.
Nanopores and Force Spectroscopy	What is "Force spectroscopy"? How can Nanopores be used to apply force?. How this is all different from bulk? Some surprising findings regarding DNA unzipping kinetics.
The physics of "Capture". How do molecules get there to start with?	The Debye Huckel approximation and understanding thermal equilibrium in liquids. Why nanopores cannot be in equilibrium? What are the consequences and why is counter-intuitive?
Sequencing, sequencing, sequencing..	What nanopores have to offer over the Next Generation Sequencing approaches? But how does it work actually?
Optical Super Resolution Microscopy	Is Super Resolution a single molecule technique? Affirmative... But we need to understand why is it the case.
Proteins and proteome sensing using Nanopores	Our glimpse to the future..Single Cell proteomics, fingerprinting versus sequencing. Will AI help?
Students oral paper presentations.	Your time has come...