ICFO

COLLOQUIUM: Digital holography for biosensing and optofluidics

ROMAIN QUIDANT

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12:00 to 13:00
Auditorium

ABSTRACT:
Biosensing technologies aim to detect bioanalytes within complex biological matrices, providing invaluable tools for addressing fundamental biological questions, diagnosing diseases, and monitoring treatment efficacy. A long-standing goal in this field is to achieve label-free, high-throughput detection of multiple analytes within complex matrices. In this presentation, we discuss how the versatile technique of digital holography can significantly contribute to this objective through three different optofluidic platforms.
Multiplexed Label-Free Immunoaffinity Assay - We introduce an optofluidic platform that integrates state-of-the-art digital holography with PDMS microfluidics, utilizing supported lipid bilayers as a versatile surface chemistry building block. This platform enables the label-free, single-particle-sensitive fingerprinting of heterogeneous extracellular vesicle

populations through a multiplexed immunoaffinity assay. We demonstrate the potential of this approach to extend beyond extracellular vesicles to single proteins.
Wide-Field, Spectrally Resolved Optical Activity Imaging - Beyond simple detection, digital holography can provide additional insights into biomolecular properties. By employing polarization-sensitive off-axis holography, our system enables single-shot retrieval of circular dichroism (CD) and optical rotatory dispersion (ORD) images. This approach not only aligns with traditional CD spectroscopy but also offers the unique capability to spatially resolve local chirality variations that are often obscured by ensemble averaging.
Dynamic, Reconfigurable Fluidic Boundaries - We present a novel optofluidic toolbox that harnesses structured light and photothermal conversion to create dynamic, reconfigurable fluidic boundaries. This system enables precise manipulation of fluids and particles by generating 3D thermal landscapes with high spatial control. Our approach mimics the functions of traditional physical barriers while offering the advantage of real-time reconfiguration for complex tasks, such as individual particle steering and size-based sorting in heterogeneous mixtures. This versatile platform has the potential to revolutionize microfluidic systems, finding applications in chemical synthesis, lab-on-chip devices, and microbiology.

BIO:

Romain Quidant received a PhD in Physics (2002) from the University of Dijon, France. He then joined the newly created ICFO in Barcelona as a postdoctoral researcher. In 2006, he was appointed junior Professor (tenure-track) and group leader of the Plasmon NanoOptics group at ICFO. In 2009, he became tenure Professor both at ICFO and ICREA. After nearly 18 years at ICFO, in June 2020, he joined the Mechanical and Process Engineering department (D-MAVT) at ETH Zurich. He is recipient of 5 ERC grants and several international and national prizes. Since January 2022, he serves as the Editor-in-chief of ACSPhotonics (American Chemical Society).
The research of the Quidant's lab focuses on nano-optics, at the interface between photonics and nanotechnology. It uses the unique optical properties of nanostructures as enabling tools to design solutions to scientific and technological challenges, in a wide set of disciplines, from fundamental physics to biotechnology. This makes its activities highly multidisciplinary, covering both basic and applied research. The most fundamental part is mainly directed towards enhanced light/matter interaction and optomechanics. From a more applied standpoint, his team investigates new strategies to control light and heat at the nanometer scale for biomedical applications, including lab-on-a-chip technology, and for reconfigurable planar optics.

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