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IAS SYMPOSIUM

Mathematics for Cryo-electron Microscopy

Prof Ning Gao, Professor of Life Sciences, Peking University
Prof Amit Singer, Professor of Mathematics, Princeton University

Date : 1 Sep 2017 (Friday)
Time : 2:30 - 6:00 pm
Venue : IAS Lecture Theater, Lo Ka Chung Building, Lee Shau Kee Campus, HKUST

Save to Calendar Directions

Rundown

2:30 - 3:45 pm	Cryo-electron Microscopy Breakthroughs and Applications in 3D Biological Imaging **Speaker: Prof Ning Gao**
3:45 - 4:00 pm	Coffee break
4:00 - 5:15 pm	Mathematics for Cryo-electron Microscopy **Speaker: Prof Amit Singer**
5:15 - 6:00 pm	Reception

Abstracts

Cryo-electron Microscopy Breakthroughs and Applications in 3D Biological Imaging

With breakthroughs in electron detector technology, cryo-electron microscopy (EM) is going through a revolutionary transformation, overtaking X-ray crystallography as a major tool for high-resolution 3D biological imaging, especially for molecular machines that are oscillating among multiple compositional and conformational states. In this lecture, the speaker will use a few biological applications to illustrate the development of cryo-EM over the years. Particularly, he will focus on the current limitations in the workflow of sample preparation and data processing, and discuss the needs for improving the method from sample-freezing techniques to imaging classification algorithms.

Mathematics for Cryo-electron Microscopy

Single particle cryo-EM recently joined X-ray crystallography and nuclear magnetic resonance spectroscopy as a high-resolution structural method for biological macromolecules. Furthermore, cryo-EM has the potential to analyze compositionally and conformationally heterogeneous mixtures and, consequently, can be used to determine the structures of complexes in different functional states. The 3D-structure and the possible structural variability need to be determined from many noisy two-dimensional tomographic projections, whose viewing directions and in-plane rotations are unknown. In this lecture, the speaker will give an overview of the computational challenges in cryo-EM analysis and how he and others are trying to face them, focusing on 3D ab-initio modelling and the heterogeneity problem of determining structural variability.

About the speakers

Prof Ning Gao is Professor of Life Sciences at Peking University. He moved across the street at the beginning of 2017 from Tsinghua University where he was assistant, associate and full Professor from 2008 to 2017. He received his training in cryo-EM with Prof Joachim Frank first as a graduate student in the Wadsworth Center, Albany and then as a postdoctoral associate at Columbia University Medical Center in New York. During his training, he contributed to the early development of cryo-EM technology as an imaging tool for biological samples. As an independent investigator, he remains committed to the development of cryo-EM methodologies and applications. As a structural biologist, he has a deep interest in the functions and mechanisms of macromolecular machines, in particular, the study of ribosome biogenesis and translational regulation. More recently, he has developed an interest in the study of eukaryotic DNA replication.

Prof Amit Singer is Professor of Mathematics at Princeton University, where he also serves as member of the Executive Committees of the Program in Applied and Computational Mathematics (PACM) and of for the Center for Statistics and Machine Learning (CSML). He joined Princeton as an Assistant Professor in 2008. From 2005 to 2008 he was the Gibbs

Assistant Professor in Applied Mathematics at the Department of Mathematics, Yale University. Prof Singer received the PhD degree in Applied Mathematics from Tel Aviv University in 2005. He served in the Israeli Defense Forces during 1997-2003. He received numerous honors including the Simons Math+X Investigator Award (2017), the US National Finalist for Blavatnik Awards for Young Scientists (2016), the Moore Investigator in Data-Driven Discovery (2014), the Simons Investigator Award (2012) and the Alfred P. Sloan Research Fellowship (2010). His current research focuses on theoretical and computational aspects of data science, and on developing computational methods for structural biology.

For attendees' attention

The symposium is free and open to all. Seating is on a first come, first served basis.

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