Seminar Announcement

Zhizhen Jane Zhao
Courant institute of Mathematical Sciences
New York University

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Green Hall, Room 0120
10:10 AM

Class Averaging of Cryo-Electron Microscopy Images

Abstract: The three-dimensional structure of a protein or protein complex provides crucial insights into its biological function. Cryo-electron microscopy (EM) is well suited for obtaining structural information for large protein complexes. Class averaging is a crucial step in cryo-EM, because the signal to noise ratio (SNR) of raw projection images is typically too low for ab initio modeling. It amplifies the SNR by averaging noisy images of similar viewing directions. The averaged images form the input to ab initio reconstruction algorithms to determine the 3D electron density map of a protein complex. However, without prior knowledge of the protein complex, identifying images from similar viewing directions is challenging for large datasets at low SNR.

Our class averaging procedure uses fast steerable PCA to compress and denoise images. We construct rotational invariant representation of 2D images and use randomized algorithms for dimensionality reduction and approximate nearest neighbor search to achieve efficient initial classification (near linear running time in the number of images). The initial classification is further improved by vector diffusion map, which takes into account the nonlinear geometry of the data manifold and the linear transformations between data points. We show that our procedure succeeds at remarkably low levels of SNR.

Bio: Zhizhen Zhao received her B.A. and M.Sc. degrees in Physics from Trinity College, Cambridge University in 2008, and her Ph.D degree in Physics from Princeton University in 2013. Since September 2013, she has been with the Courant institute of Mathematical Sciences at New York University. She is currently a Courant Instructor at NYU. Her research interests include applied and computational harmonic analysis, signal processing, data-driven methods for dynamical systems, and the applications in structural biology and atmospheric and oceanic sciences.

Host: Dr. Arye Nehorai