UC RIVERSIDE UNIVERSITY OF CALIFORNIA | Materials Science and Engineering

WINTER 2020 COLLOQUIUM SPEAKER

Super-resolution in Real and Reciprocal Spaces

Super-resolution imagery techniques have been shown as black magic in fictionalized crime TV shows such as CSI. Similar techniques are now ubiquitous in modern digital cameras and cell phones. In scientific research, super-resolution (SR) techniques have revolutionized fields such as fluorescence microscopy and biology (The Nobel Prize in Chemistry 2014), and new SR techniques continue to be invented for and applied in real-space imaging instruments. In this talk, recent applications of super-resolution techniques in reciprocal-space imaging of quantum excitations by neutron scattering spectrometers will be presented, along with relevant real-space SR imaging techniques. Neutron spectroscopy is a tool of choice for studying exotic magnetic and vibrational excitations in solids. Direct Geometry Spectrometers (DGS) at spallation neutron sources allow the collection of massive datasets, but the quantum excitations are obscured by asymmetric instrument broadening that varies in the dynamic range of measurement. Clearly resolving fine features in the excitation spectra of novel materials is a long-standing challenge that pushes the limit of DGS. In this presentation, we will discuss two super-resolution techniques recently in development for DGS spectroscopy. Multi-frame super-resolution imagery principles and techniques were found applicable to DGS data, and 5X resolution enhancements were achieved inmeasurement of phonon density of states, a reduced representation of vibrational property of condensed matter. The second technique was inspired by image correlation techniques crucial for stereo imaging or 3D reconstruction. It was adapted to tackle the problem of constraining spin-wave models, a routine challenge in understanding neutron scattering data for magnetic materials.

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Dr. Jiao Lin is currently Principal Computational Scientist at Satelytics Inc., leading research and development to bring scalable machine learning algorithms to remote sensing for a variety of industrial applications in Oil&Gas, Agriculture, Mining, and Environmental Services. He received his PhD in Materials Science from CalTech in 2004. Prior to Satelytics, he was Computational Scientist at the Caltech Center for Advanced Computing Research (2004-2015), and the Neutron Scattering Division at Oak Ridge National Lab (2015-2019). He has a wide range of expertise in scientific computing for data reduction, transformation, analysis, modeling and simulation in materials science, scattering science, imaging, and remote sensing.

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