Nonlinear Super-resolution Imaging with Upconversion Nanoparticles

*Chaohao Chen**
School of Mathematical and Physical Sciences,
Faculty of Science, The University of Technology Sydney
Chaohao.chen@uts.edu.au

Optical super-resolution imaging is a powerful technique widely used in life sciences to observe the activities and morphology of biological samples at subcellular scales. In recent years, significant advancements have been made in super-resolution imaging techniques. However, these techniques often require extremely complex instrumentation, which, coupled with their high cost and increasingly intricate operation, hinders the development and application of super-resolution imaging technologies. This talk will primarily introduce our recent development of a novel super-resolution imaging technique based on rare-earth upconversion nanoparticles. Through investigations into the energy transfer mechanisms and multi-color nonlinear responses of rare-earth ion-doped nanocrystals, we elucidate the physical mechanisms underlying their nonlinear emission. We have developed a series of near-infrared single-beam super-resolution techniques by combining techniques from fields such as optical field manipulation and image processing algorithms. These approaches aim to overcome the limitations of optical diffraction and provide more straightforward pathways to achieve sub-diffraction-limited imaging. Additionally, this talk will provide a brief overview of our ongoing project of mid-infrared single-pixel imaging with silicon detectors at room temperature. This work aims to address the limitations of current mid-infrared imaging technologies by advancing knowledge of the energy-looping mid-infrared detection mechanism to develop a robust laser-free integrated imaging system design, eliminating the need for conventional cryogenic cooling and complex optics.

References:

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