

# The Hong Kong University of Science & Technology

### **Department of Mathematics**

## PhD Student Seminar

# Mathematical Theory of Resolution Limit and Super-resolution

by

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#### <u>Abstract</u>

Resolution limit is a fundamental question in imaging that can trace back to the 19th century. Lord Rayleigh proposed the well-known Rayleigh criterion to determine the resolution limit. However, this criterion is empirical and applies only to classical imaging method and instrument. For modern computational imaging methods, a rigorous mathematical definition of resolution limit is needed.

We derive a mathematical theory of resolution limit for a general imaging system with a specified point intensity pattern or point spread function. It quantitively characterize the dependence of resolution limit with respect to signal to noise ratio and the sparsity of point sources. This resolution limit also indicates the severe ill-posedness of the inverse problem. To break the resolution limit to achieve the so-called super-resolution, multiple-illuminate turned out to be a powerful approach. We analyze the performance of multi-illumination and derive the corresponding resolution limit. Our results provide a quantitative understanding of the benefit of using multi-illumination to enhance the resolution. In addition, we propose an efficient numerical methods to solve the inverse source problem which does not require the sources to be located on specified grid points.

# Date: Wednesday, 24 April 2019 Time: 3:30 p.m.- 4:30 p.m. Venue: Room 5510 (near Lifts 25-26)

All are welcome!