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The Hong Kong University of Science and Technology

Department of Mathematics

Seminar on Applied Mathematics

Computing Images from Weak Optical Signals

by

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Abstract

In conventional imaging systems, the results are poor unless there is a physical mechanism for producing a sharp image with high signal-to-noise ratio. In this talk, I will present two settings where computational methods enable imaging from very weak signals: range imaging and non-line-of-sight (NLOS) imaging.

Lidar systems use single-photon detectors to enable long-range reflectivity and depth imaging. By exploiting an inhomogeneous Poisson process observation model and the typical structure of natural scenes, first-photon imaging demonstrates the possibility of accurate lidar with only 1 detected photon per pixel, where half of the detections are due to (uninformative) ambient light. I will explain the simple ideas behind first-photon imaging and lightly touch upon related subsequent works that mitigate the limitations of detector arrays, withstand 25-times more ambient light, allow for unknown ambient light levels, and capture multiple depths per pixel.

NLOS imaging has been an active research area for almost a decade, and remarkable results have been achieved with pulsed lasers and single-photon detectors. Our work shows that NLOS imaging is possible using only an ordinary digital camera. When light reaches a matte wall, it is scattered in all directions. Thus, to use a matte wall as if it were a mirror requires some mechanism for regaining the one-to-one spatial correspondences lost from the scattering. Our method is based on the separation of light paths created by occlusions and results in relatively simple computational algorithms.

Date: Friday, 21 June 2019
Time: 9:30a.m. – 10:30a.m.
Venue: Room 4504, Academic Building, (Lifts 25-26), HKUST

All are welcome!