



DoNuTS Technical Meeting

Time: 1600 Wednesday, 18 February 2009

Place: NE Conference Room, 1106 Etcheverry

Speaker: Chad Goerzen, Tel-Aviv University and NASA

Subject: Imaging Without Optics: Localization of Radiation Sources using Lensless Sensors

Recently, the method of maximum likelihood (ML) estimation has been applied to imaging systems with large amounts of blur. In fact, sharp images can be obtained from systems of sub-sensors with arbitrary blur functions. By assuming a model of distant point sources illuminating or irradiating the sub-sensors, the system determines the ML estimate of location and intensity of the source radiation. An important advantage of this type of sensors is that they can be used for imaging of any type of optical and non-optical radiation.

Performance of this class of sensor is characterized here using the Cramér-Rao Lower Bound (CRLB), and these results are verified by numerical testing. Results show that errors in estimating source angles and magnitudes are inversely proportional to the signal-to-noise ratio in sub-sensors and to the square root of the number of the sub-sensors, with the additional property that the resolving power is limited by the angular distance between sub-sensors. Analysis of algorithmic complexity and methods to decrease complexity are considered, and it is shown that computational complexity of the task may be decreased from exponential-time to a polynomial-time.

These results can be used to identify the 3-dimensional location of radiation sources by using arrays of ordinary type simple sub-sensors. They may also be useful for the study of image-forming systems in general, including microscopic imaging systems, and biological imaging organs such as skin vision, simple eyes, or pit eyes.