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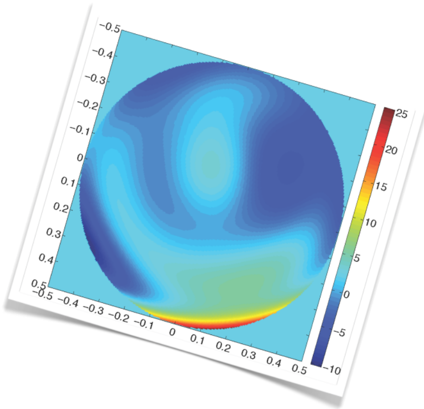
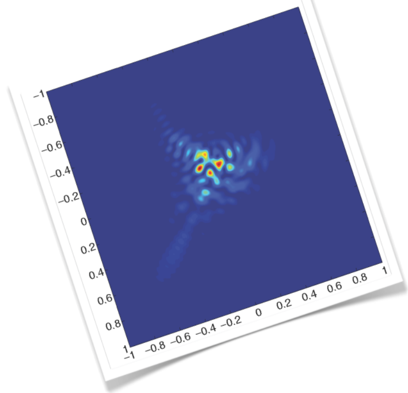
Computational Optical Imaging: A Task Specific Approach





Dr. Amit Ashok

Optical imaging systems have evolved with the goal of producing an isomorphic measurement of a scene. Typically such imaging systems place the sole burden of image formation on the optical front-end while the role of detector array is relegated to sampling and digitization of the optical image with minimal degradation. Post-processing is usually viewed as a tool to mitigate image artifacts/noise, apply compression, and/or to enable exploitation tasks such as pattern recognition, target tracking etc. The traditional design approach optimizes each sub-system (optics, detector, post-processing) separately and often results in sub-optimal designs. In contrast, computational optical imaging exploits the optical, detector, and post-processing design degrees of freedom jointly to achieve end-to-end system optimality. Furthermore, such a design approach is especially suited to task-specific imaging as it allows one to incorporate knowledge of scene statistics and specific task in the system design. In this talk, examples of computational imaging system design for various tasks, such as image formation and pattern recognition, will be discussed to highlight the power of the joint-design framework. A novel measurement basis design for compressive imaging, a sub-class of computational imaging, will also be presented and compared to the de-facto random measurement basis standard in the compressed sensing community. Finally, a task-specific information-theoretic approach to imaging system design and analysis will be discussed in the context of the fundamental limits of imaging systems.

4PM, WEDNESDAY, SEPTEMBER 14, 2011

Carlson Auditorium, Center for Imaging Science (Bldg. 76)