Computational Imaging

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Four hundred years after Galileo's invention of the telescope, it is awe inspiring to see how far imaging has progressed. In particular, the past two decades have witnessed radical change that has had broad implications to society. From cameras a person can swallow to provide real-time images of their intestine to cameras for catching speeders and red-light runners to cell-phone cameras, cameras are a ubiquitous part of our networked world. The marriage of optics and electronics, as well as optics with signal processing, is poised to have a revolutionary impact on future imagers.

I refer to one aspect of this revolution as computational imaging. Describing the imaging as "computational" implies that optics alone does not carry the burden of forming an image. Rather, the burden is shared with the optoelectronics and the post-detection signal processing. System performance is controlled through concurrent design and joint optimization of all elements. The individual components of the imaging system (front end optics, detectors, and post-detection processing) are no longer designed independently.

To underscore the potential this new approach brings to imaging I present three examples of capabilities that are not possible using conventional means: extended depth-of-field, thin imaging, and compressive imaging. In particular, I highlight applications to millimeter wave imaging.

4 pm, Wed., January 20, 2010
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