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Transport-Aware Cameras

Kyros Kutulakos
University of Toronto

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Abstract
Conventional cameras record all light falling onto their sensor regardless of the path that light followed to get there. In this talk I will discuss our nearly decade-long research on video cameras that can be programmed to record just a fraction of the light coming from a controllable source, based on the actual 3D path followed. Live video from these cameras offers a very unconventional view of our everyday world in which refraction and scattering can be selectively blocked or enhanced, visual structures too subtle to notice with the naked eye can become apparent, and object appearance can depend on depth. I will discuss the unique optical properties and power efficiency of these "transport-aware" cameras, as well as their use for 3D shape acquisition, robust time-of-flight imaging in direct sunlight, looking through skin or fog, and analyzing the electrical grid at city scale. Last but not least, I will briefly describe our progress on an emerging family of programmable CMOS image sensors that could be thought of as a "swiss army knife" for coded imaging: they open the door for transport-aware imaging on portable---or even hand-held---devices, and offer other unique capabilities such as one-shot high-dynamic range imaging and learned snapshot 3D sensing.

Bio
Kyros Kutulakos is a Professor of Computer Science at the University of Toronto. He received his PhD degree from the University of Wisconsin-Madison in 1994 and his BS degree from the University of Crete in 1988, both in Computer Science. Kyros has been a pioneer in the area of computational light transport, developing theoretical tools and computational cameras to analyze light propagation in real-world environments. He is the recipient of an Alfred P. Sloan Fellowship, a Marr Prize in 1999, a Marr Prize Honorable Mention in 2005 and five more paper awards (CVPR 2019, CVPR 2017, CVPR 2014, ECCV 2006 and CVPR 1994). He was Program Co-Chair of CVPR 2003 and ICCV 2013, and also served as Program Co-Chair of the Second International Conference on Computational Photography in 2010.

Host
Professor Qi Guo, guo675@purdue.edu, 617-803-5454