Towards Computational Imaging Systems that Optimize Themselves

Kyros Kutulakos, University of Toronto

The last two decades have witnessed an explosion of off-the-shelf devices for illumination and sensing---from projectors to programmable lasers, to cellphones, time-of-flight cameras, and beyond. As these devices become increasingly programmable, the question of how to program them optimally for specific tasks is more relevant than ever.

I will focus on two specific aspects of this question, in the context of structured-light triangulation. First, programmable coded-exposure sensors vastly expand the degrees of freedom of an imaging system, essentially redefining what it means to capture images under structured light. I will discuss our efforts to understand the expanded capabilities of such systems, and to build custom CMOS sensors that realize them. Second, I will outline ongoing work on turning structured-light triangulation into an optimal encoding-decoding problem derived from first principles. This opens the way for adaptive systems that can learn on their own how to optimally control their light sources and sensors, and how to convert the images they capture into accurate 3D geometry.