Imaging Sciences Pathway
Washington University in St. Louis

Imaging Science Seminar

Co-Designing Measurement and Inference for Photography and Vision

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Abstract: As we build algorithms to understand the world from images, videos, and other visual measurements, we must deal with the fact that these measurements are ambiguous towards the properties of the scenes they represent. Computer vision seeks to manage this ambiguity by learning statistical models of the visual world, to exploit the structure that exists in natural scenes. However, as these models become increasingly sophisticated and we begin to saturate the performance possible with traditional images, researchers have also started looking at changing the kind of images we take and provide as input to vision algorithms. The goal of computational photography is to co-design the measurement process and inference algorithm so that they are complementary, and provide increased accuracy under the same physical constraints (such as light budget, sensor size, exposure time, etc.).

In this talk, I will give a broad overview of research in the field computational photography, and talk about several applications where jointly designing the capture process with estimation methods has enabled better computational recovery of scene attributes. I will then describe recent work on a learning-based approach to automate this joint design process. Using color imaging as an example task, I will introduce a framework where the camera's measurement process is encoded as a neural network "layer," whose learnable weights parameterize the possible measurement choices for the sensor. This layer is trained together with a deep neural network that carries out inference on the corresponding measured intensities, with the common objective of maximizing the quality of the final output. I will show that this approach is able to automatically discover a measurement strategy that, when used with the jointly learned inference network, significantly outperforms traditional sensor designs.

Time: 8:40-9:30 a.m.

Date: Friday, September 29, 2017

Room: 0120 Green Hall

Ayan Chakrabarti's research interests are broadly in the fields of computer vision, computational photography, and machine learning. He works on developing systems that can recover physical reconstructions and semantic descriptions of the world from visual measurements, for applications in robotics and autonomous vehicles, consumer photography, graphics and virtual reality, and more. His research focuses on ways to learn and exploit the statistical structure of natural images and scenes, in order to design efficient and accurate inference algorithms, as well as new kinds of high-capability sensors and cameras.