Project Proposal

Rendering three dimensional images is classically done by using a three dimensional description of the scene. This often consists of a specification of the geometry, lighting conditions, and material properties.

One important aspect of rendering is describing the light transport of the scene, that is how light sources and objects in the scene emit and respond to light.

In some contexts, this information is not always available, however it is desirable to render the scene from a different view or using different lighting conditions. It is possible to infer the light transport from a collection of images and accomplish the task. This is generally known as image based relighting.

Ng. et. al [Ng et al. 2003] expressed the image I of a scene as a linear product of the *light transport matrix* T and the incident illumination vector L as

$$I = TL.$$

The image is expressed as a vector of length P where there are P pixels and the illumination vector is usually represented as an environment cube map with Q pixels. Thus T is a $P \times Q$ matrix where each entry T_{ij} expresses the contribution of light texel j to image pixel i.

While there has been much work in this area, including some work using neural networks [Ren et al. 2015], there has been no attempt to train a neural network to exploit both sparsity and coherence of the light transport matrix.

This task would be similar to training a neural network to learn compressive sensing, but in the context of image based relighting. In compressive sensing, one has measurements of the form $y = \phi^T x$ where the matrix ϕ^T is known as the measurement ensemble. This maps well to the problem of image based relighting, where L corresponds to x, I corresponds to y, and ϕ^T corresponds to T. Furthermore, T is usually large and the number of image samples is usually sparse relative to T. So, the goal here would be to train a neural network to approximate the novel lighting conditions $I = TL$ from known conditions $TL_1, \ldots, TL_k$

References

NG, R., RAMAMOORTHI, R., AND HANRAHAN, P. 2003. All-frequency shadows using non-linear wavelet lighting approximation. In *ACM SIGGRAPH 2003 Papers*, ACM, New York, NY, USA, SIGGRAPH '03, 376–381.

REN, P., DONG, Y., LIN, S., TONG, X., AND GUO, B. 2015. Image based relighting using neural networks. *ACM Trans. Graph. 34*, 4 (July), 111:1–111:12.