Deep Illumination Estimation

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Motivation

- Modern Augmented Reality applications rely on superimposing rendered virtual objects on a real scene in real-time.
- An object's appearance is made up of its material properties, its geometry and the incident light. In the case of AR, the lighting of the real scene is not known, and must be estimated for a realistic rendering.
- Current illumination estimation methods are primitive, often taking an average intensity of the background or a single light direction under significant constraints. Hollywood films use physical reflectance probes under different exposures to capture illumination, which is unsuitable for AR.

Overview

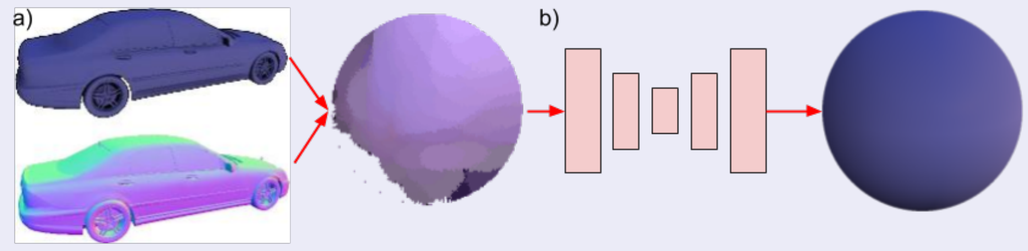
- We aim to use a Conv-Deconv approach to estimate illumination, from the appearance and known geometry of a scene. Using this information, characters and objects can be superimposed on the scene with realistic lighting parameters.
- The main challenge of this task is constraining the problem for the CNN to learn a mapping from appearance and geometry to a lighting representation. To do this we create an intermediary 'Reflectance Map' representation of objects that encodes both geometry and appearance as a Gauss Sphere.
- We define our output as an 'Environment Map' in High Dynamic Range that captures all the incident light at a single point.

Progress

- Implemented a GPU-Accelerated sparse Reflectance Mapper in Tensorflow
- Trained a CNN to learn a interpolation from Sparse to Dense reflectance
- Created a CNN to learn a mapping from scenery and RM to illumination
- Produced a system for rendering objects with predicted parameters as part of the Tensorflow graph

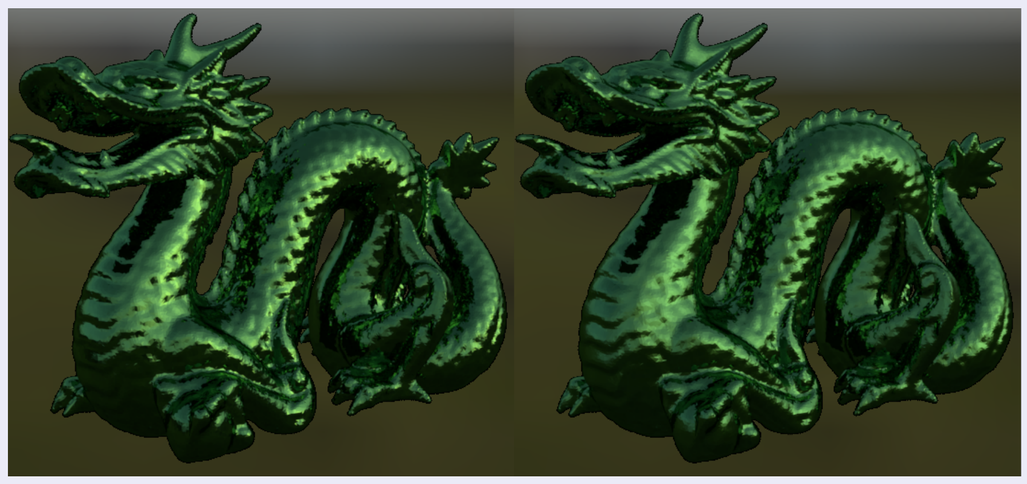
Reflectance Mapping

We are able to calculate a Sparse RM, which can be used to estimate a Dense RM, by taking the brightest pixel for each surface normal in an RGBD image.



Preliminary Results

Ground Truth (left), Rendering using predicted Illumination (right)



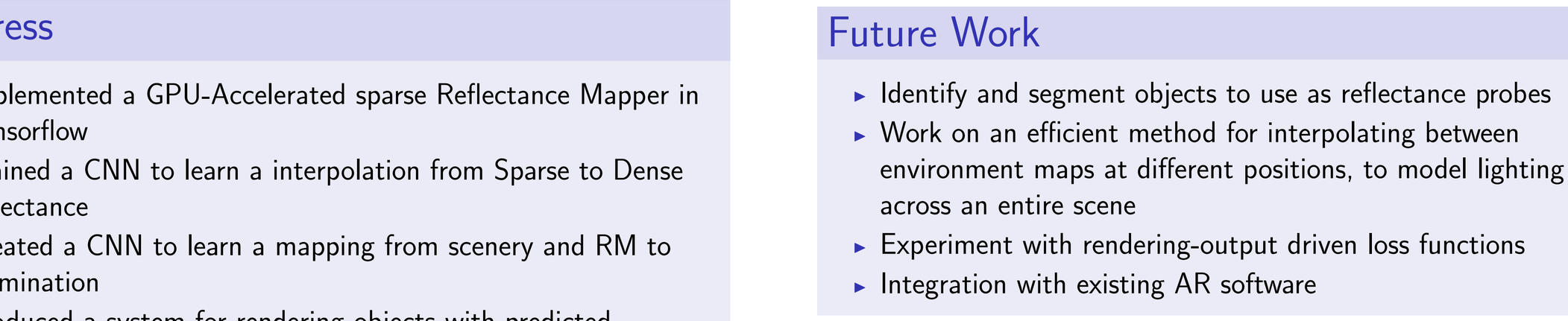
We are able to estimate HDR environment maps at a single point, provided an object with known geometry as a normal image. These environment maps are used to render scenes in the Cycles Renderer.

Future Work

- Identify and segment objects to use as reflectance probes
- Work on an efficient method for interpolating between environment maps at different positions, to model lighting across an entire scene
- Experiment with rendering-output driven loss functions
- Integration with existing AR software

Acknowledgements

- 'Natural Illumination from Multiple Materials Using Deep Learning' - Konstantinos Rematas et al.
- 'Deep Reflectance Maps' - Stamatios Georgoulis et al.



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