HDR Scene Lighting Reconstruction

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

This project aims at capturing the 3d lighting setup of a scene using high dynamic range (HDR) images and a 3d reconstruction of the scene. Knowing the lighting setup can then be used to light virtual objects that have been added to the scene or to relight the scene entirely by first removing the current light and adding a different light setup.

Background and Motivation

There exist several solutions to capture HDR panoramas (HDRIs) to render scenes with natural lighting [1]. Most of them assume a spherical representation of the environment which reflects the incoming light at the center of the panorama, but all the light is projected into the scene from the same radius of the sphere, losing the 3d information of the light sources. In this project we want to build a representation that is able to model the light sources in 3d for more accurate modeling of the light in the scene. In practice a user would go around a scene capturing many HDR images from different points of view to retrieve the spatial location of the light sources in the scene. While one can differentiate between active direct light sources that emit light and indirect light that is passively reflected from other surfaces, this differentiation can be difficult in practice. As a first step the user should be able to define an intensity threshold to choose which light sources to include. Later a classification and refinement of the light sources can help to improve the results.

Student's Tasks Description

The student will learn about HDR imaging and 3d reconstruction. The tasks include

1. Capture multiple images with options for choosing the number of exposure levels
2. Combine them to HDR images
3. Track the camera pose using the images
4. Reconstruct the direct and indirect light sources in the scene

Technical Prerequisites

- Programming skills
- Image processing (helpful)
- 3d reconstruction (helpful)

References

[1] Meshroom

[3] Frahm, J. M., Koeser, K., Grest, D., & Koch, R., Markerless augmented reality with light source estimation for direct illumination, CVMP 2005

[2] Whelan, T., Salas-Moreno, R. F., Glocker, B., Davison, A. J., & Leutenegger, S., ElasticFusion: Real-time dense SLAM and light source estimation, ICRR 2016

[3] Azinovic, D., Li, T. M., Kaplanyan, A., & Nießner, M., Inverse path tracing for joint material and lighting estimation, CVPR 2019

Please send the completed proposal to tianyu.song@tum.de, shervin.dehghani@tum.de and felix.tristram@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.