EE 367 Final Project Proposal: Creation of a Light-field Image Database and State-of-the-art Depth Estimation using Light-fields

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Motivation

One of the major drawbacks for research in the area of light field images is that there currently does not exist a large accessible dataset of light field images for researchers to use. Currently there are very few light field images available online. By creating a standard dataset of natural light field images, researchers can test their algorithms on a known set of images without needing to purchase or own their own light field camera. Providing this dataset to the public will also allow users easily to compare their results to other algorithms and methods. Making this data available to the public will help spark interest in that area of light field imaging.

Light field photography has the potential to play a crucial role in computer vision. Light field cameras capture images from many different perspectives and fuse this many images into a single image. By comparing these images from different perspectives we can passively estimate the depth at different points in the scene. Using a passive approach allows the system to estimate depth in outdoor conditions, where structure illumination approaches fail. Having an accurate depth estimation opens the door for many other applications for light field imaging such as 3D reconstruction, object recognition, and augmented reality.

Related Work

Depth estimation using light-field cameras has become one of the major research topics owing to the increased popularity of light-field cameras in consumer and industrial applications. In our project we plan to explore the methods used in three state of the art depth estimation algorithms to build an improved algorithm for depth estimation. Michael Tao et al. [3] has implemented a depth-estimation algorithm which combines defocus and correspondence cues to estimate depth. The algorithm in [2] uses defocus and correspondence cues for shape estimation and further refines depth-estimation using shading information. The other state-of-the-art algorithm in [1] treats occlusions in the images explicitly and hence, tends to work better for images with occlusions. The algorithms mentioned above are three of the most recent papers in the field of depth estimation.

Project overview

This project has two main goals. The first is to create a database of light field images which is easily accessible to the research community as well as the general public. It will be a very useful resource for researchers who wish to develop and implement algorithms in this domain. It will serve as a valuable tool to anyone who wishes to learn, work with or just play around with light field images. To this end, we will use a Lytro Illum light field camera to capture a few hundred light field photographs of indoor and outdoor scenes. We will extract the raw data and the corresponding depth map of each image and create an extensive database of these light field images. We aim to capture as much variation as possible in our images. This includes but is not

limited to photographs of objects in different lighting conditions, scenes with varying depth ranges, images with dense features, images with sparse features as well as scenes with interesting features such as occlusions, motion blur and so on.

The second goal is to implement a state of the art depth estimation algorithm on the captured images. To start with, we will implement and demonstrate the depth estimation algorithms cited in our proposal. Using these implementations as a baseline, we would like to come up with a better algorithm that combines the best features of the existing algorithms as well as improves upon their limitations.

Milestones, timeline & goals

We plan to continuously be capturing images during this project. In the beginning there will be an emphasis on images that show the strengths and weaknesses of the three algorithms presented in the related works section.

2/8 - 2/15 Collect light-field images for our database. We also aim collect relevant images which can help us get started with the implementation of the depth-estimation algorithm.
2/15 - 2/22 Interpret results of the previous algorithms on the images we collected. Start implementation of our own depth algorithm.
2/22 - 2/29 Start designing and implementing the data base
2/29 - 3/7 Continue working on database and algorithm.
3/7 - 3/9 Create poster for poster session
3/9 - 3/14 Capture final images for database, Write report.

References

[1] Wang, Ting-Chun, Alexei A. Efros, and Ravi Ramamoorthi. "Occlusion-aware Depth Estimation Using Light-field Cameras." *Proceedings of the IEEE International Conference on Computer Vision*. 2015.

http://cseweb.ucsd.edu/~viscomp/projects/LF/papers/ICCV15/occlusion_ICCV15.pdf

[2] Tao, Michael W., et al. "Depth from shading, defocus, and correspondence using light-field angular coherence." *Computer Vision and Pattern Recognition (CVPR), 2015 IEEE Conference on*. IEEE, 2015.

http://cseweb.ucsd.edu/~viscomp/projects/LF/papers/CVPR15/shading_CVPR15.pdf

[3] Tao, Michael, et al. "Depth from combining defocus and correspondence using light-field cameras." *Proceedings of the IEEE International Conference on Computer Vision*. 2013.
http://cseweb.ucsd.edu/~viscomp/projects/LF/papers/ICCV13/depth_ICCV13.pdf