Dynamic Depth of Field Image Rendering

Project Proposal

Junnan Liu

Motivation

Rendering image based on depth of field is an important artistic tool that can be used to emphasize a certain subject of a photograph. In a real camera, aperture adjustment is an important feature. However, once this is fixed, the image will be clear at a certain focus plane and within the depth of field. The image obtained from the camera directly cannot re-focus on another depth of field unless one changes the setting in the camera. This is limited by the nature of the image formation.

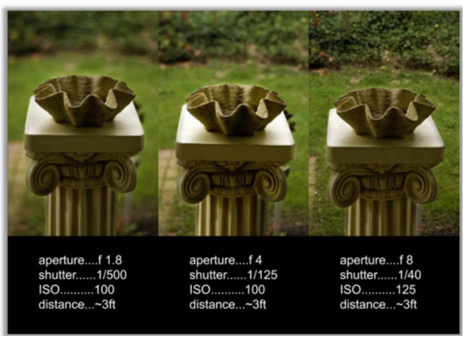


Figure 1 Real Camera Changing Aperture Effect
Image Source: http://photographywisdom.com/
EE367-Lecture 3

This project takes an input of an image with a certain depth of field and can dynamically obtain a focus blur. During post-processing, depth of the RGB image will be calculated first to obtain RGB-D information. After that, depending on the depth information and user input depth-of-field information, the input image will have some areas up-sampled and some other areas down-sampled to obtain focus blur.

Overview

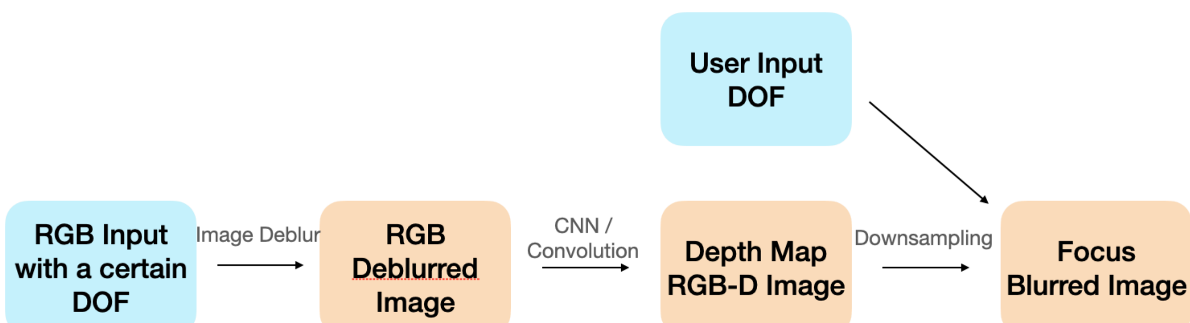


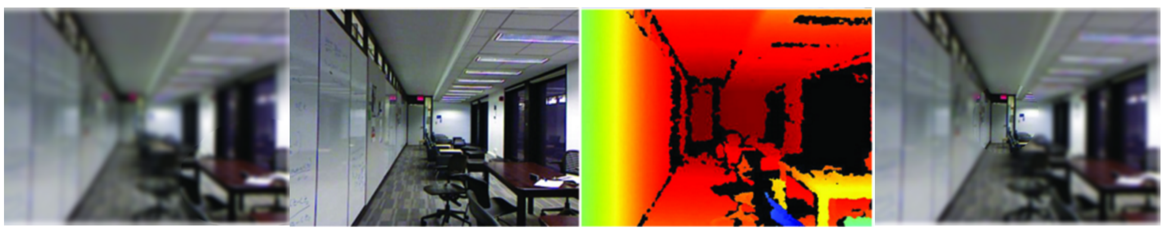
Figure 2 Block Diagram of Image Post Processing

Dynamic depth of field image rendering simulates the focus properties of a camera lens. In real life, a camera can only focus sharply on an object at a specific distance given the focal plane and circle of confusion. Objects nearer or farther from the camera are out of focus. This project takes a RGB image as an input, first generate the depth information to create a 3D RGB-D image. Retrieving the depth information from single image still remains challenging because human eyes use multiple cues in combination to estimate the depth information to overcome the information

lose from 3D scene to a 2D image. To overcome this, one can use CNN (convolution neural network) or traditional PSF to obtain depth information.
Dataset:
NYU_V2 for indoor image https://cs.nyu.edu/~silberman/datasets/nyu_depth_v2.html
Make3D for outdoor image http://make3d.cs.cornell.edu/data.html

After obtaining the depth map, user defined a specific depth of field and the strength of rendering. With these dynamic inputs, an initialization of rendering pixel window is defined at the depth outside the depth of field. And will follow circle of confusion trend.

Final Goal
When use input an image that comes with a blurry area (with a depth of field), a chain of images expected to be obtained are shown as below in Figure 3. The final goal is to dynamically change the focus blurry area as expected.


(a) (b) (c) (d)
Figure 3 (a) Input Image (focused at close distance) (b) Deblurred Image (c) Depth Map (ground true image) (d) Rendered Image with a user defined DOF. Image from NYU_V2 for indoor image https://cs.nyu.edu/~silberman/datasets/nyu_depth_v2.html

Related Work
[1] I. Laina, C. Rupprecht, V. Belagiannis, F. Tombari and N. Navab, "Deeper Depth Prediction with Fully Convolutional Residual Networks," 2016 Fourth International Conference on 3D Vision (3DV), Stanford, CA, USA, 2016, pp. 239-248, doi: 10.1109/3DV.2016.32.
[2] D. Eigen, C. Puhrsch, and R. Fergus. Depth Map Prediction from a Single Image using a Multi-Scale Deep Network. *arXiv 1406.2283*
[3] D. Eigen, and R. Fergus. Predicting Depth, Surface Normals and Semantic Labels with a Common Multi-Scale Convolutional Architecture. *arXiv 1411.4734*
[4] Kosloff, T., and Barsky, B. 2007. An algorithm for rendering generalized depth of field effects based on simulated heat diffusion. In Proc. ICCSA, 1124--1140.

Milestones
2.14 – 2.16 Programming platform set up
2.16 – 2.18 Image deblurring
2.18 – 2.22 Dataset post processing
2.22 – 3.6 Obtain depth information from single RGB image
3.6 – 3.12 Focus blur based on depth map information
3.12 – 3.17 Report and presentation