Reconstruction light field image for compression

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Abstract

In this paper, we address the overview of reconstruction light field image for compression, which appropriately applicable to a raw light field image. The process starts to locate microlens image centers using the convolution method. Then, the next step applies demosaicing, vignetting correction, and rotation-scaling to convert the raw image with integer spaced centers and orthogonal grid. Finally, the transformation operation is handled to regularize and reshape the image. Therefore, the reconstruction light field image can be compressed by the image compression method.

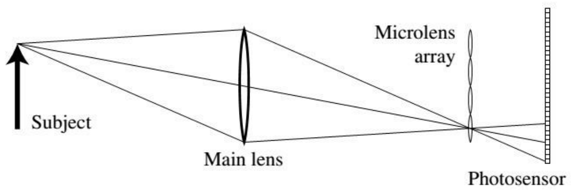
1. Introduction

Light field imaging has been recently introduced to the mass market by the handheld plenoptic camera, like Lytro [1], and Raytrix [2]. Techniques have been developed to extract the depth information and to reconstruct images with viewpoint changes at different focus planes using a single shot of the scene. Light field images capture information about the intensity of light in a scene and also information about the direction of the light rays in space. They are typically acquired with a light field camera enhanced by an array of micro-lenses placed in front of an otherwise conventional image sensor. Thus, light field acquisition and processing present high feasibility in the applications like digital refocusing, depth estimation, free-viewpoint image synthesis, 3D displays, and panorama image generation.

Thus, light field acquisition and processing present high feasibility in the applications like digital refocusing, depth estimation, free-viewpoint image synthesis, 3D displays, and panorama image generation. Meanwhile, because of the variation in the distribution of the signal and the correlation among each dimension, how to represent and compress the light field has become an attractive problem. Then, this paper describes the preprocessing light field image for the compression.

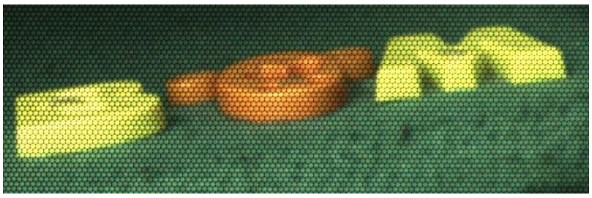
2. Light field camera

A light field camera consists of a photographic main lens, a microlens array, and a photo sensor array. Fig. 1 illustrates the layout of these components. The main lens may be translated along its optical axis, exactly as in a conventional camera, to focus on a subject of interest at a desired depth. As shown in Fig. 1, rays of light from a single point on the subject are brought to a single convergence point on the focal plane of the microlens array. The microlens at that location separates these rays of light based on direction, creating a focused image of the aperture of the main lens on the array of pixels underneath the microlens.



(Figure 1) The light field camera design

So each point of the object through a microlens is imaged as a macropixel capturing angular information instead of a pixel in traditional camera images. A light field image is composed of all the hexagonal macropixels, as illustrated in Fig.2 captured by Lytro camera [1].

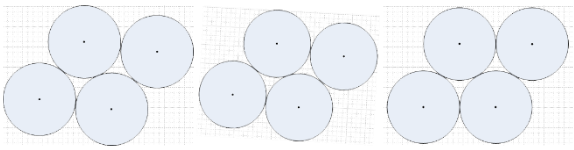


(Figure 2) Close-up raw lenselet image

3. Light field image reconstruction

3.1 Reconstruction

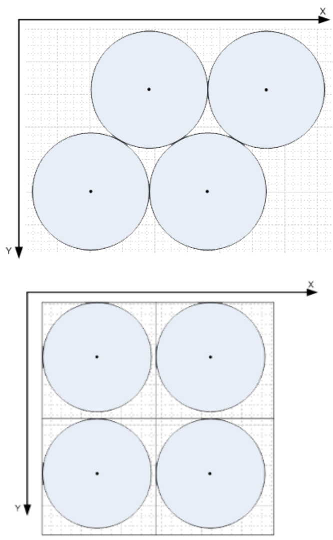
First, the process detects microlens image centers by capturing an image taken through a white Lambertian diffuser. The microlens centers in the raw image are computed as the local maximum position of the convolution between the white image and the mask. The brightest spot in each white microlens image approximates its center. After that, the method reconstructs the raw image using a process consists of three steps [3]: The process begins by demosaicing the raw image. This step reconstructs a full color light field image. Then, correcting vignetting by dividing the white image. This process removes a darkness area near the edges of pixels. Lastly, the procedure resamples the image, rotating and scaling so all microlens center fall on pixel centers. The process is shown as Fig. 2.



(Figure 3) Reconstruction raw light field image

3.2 Transformation

The process applies a linear transformation to reconstruct the image for avoiding the overlapping pixel. Since the compression methods almost use the block-based algorithm for encoding the video/image. Then the encoder cannot partition each microlens image into a block, which will affect the compression efficiency. Therefore, the renew block will cover one aligned microlens image.



(Figure 4) Linear transformation and interpolation

4. Image compression

2.1 JPEG and JPEG2000

The JPEG Standard [4] is based on the use of DCT in 8 × 8 blocks, following by quantization and entropy coding. The block approach leads to a better correlation of the input data, enhancing the algorithm performance. But this lead to the blocking artifacts where discontinuities appear between the blocks.

The JPEG2000 is also based on the wavelet transform, and can achieve up to 90% of compression without loss of quality. It uses the EBCOT (Embedded Block Coding with Optimized Truncation) [5] and is capable of lossy and lossless compression. The JPEG2000 also uses the wavelet transform, but the main difference is the use of an adaptive arithmetic coding that explores the intensity of the wavelet coefficients to generate a number of lower magnitudes based on the neighbor coefficients.

5. Conclusion

In this paper, we described a preprocessing method for light field image compression. We applied light field image reconstruction using demosaicing, vignetting correction, and rotation-scaling. After that the raw image is reshaped and regularized in linear transformation process. Finally, the reconstructed light field image is complete for compression.

Acknowledgement

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