Panorama Based on Light Field Images

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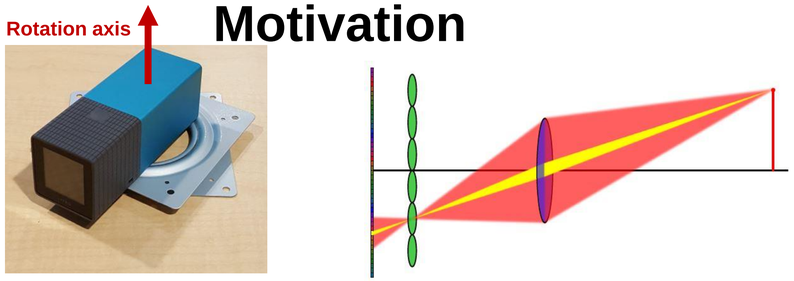
Motivation



Recently, light field imaging has been a very heated topic because of its post-focus ability and richer information (for example, depth information) than convention 2D picture. Inspired by this novel technology, we want to generate panorama from light field (plenoptics) images. For instance, panorama of a scene at a specific focus.

Figure on the left shows the first-generation Lytro camera and the rotation stage we use. On the right [3] is the illustration of lenslet-based plenoptic camera. Light coming from right is focused by the main lenslet (blue) onto the lenslet array and then split by sub-lenslets.

Methodology

Camera Calibration and Finding Rotation Axis: Camera Calibration is achieved by light field toolbox V0.4 on MATLAB. And we find the rotation axis via motion parallax.

Depth map: From focal stack and perspective views extracted by Lytro desktop, we generate the depth map via 3 methods: locally standard deviation, Laplacian filter, and gradient-based method.

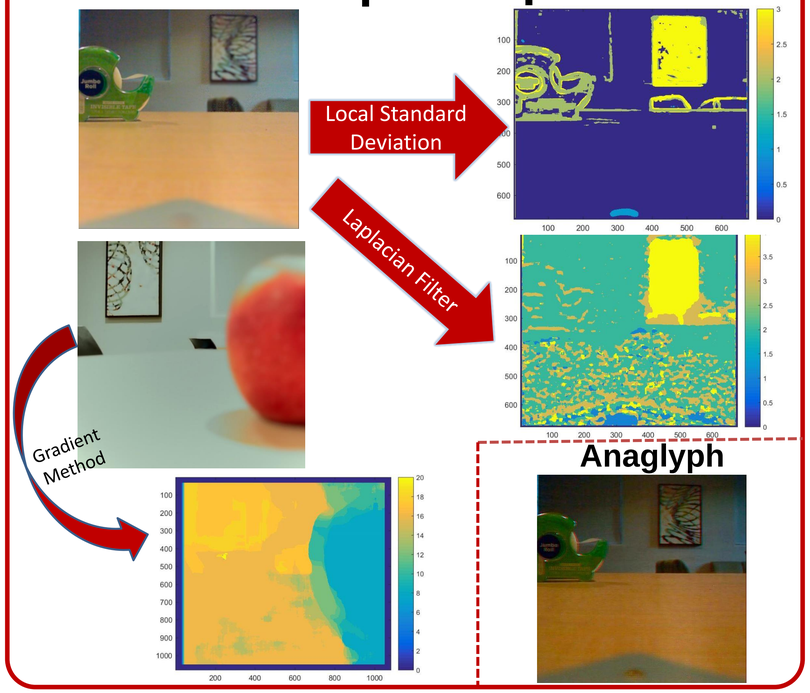
Anaglyphs: The anaglyphs is produced from the left-most one and right-most one in the sub-image array.

Panorama: We design an algorithm to automatically stitch the target image with the most matched focused-image.

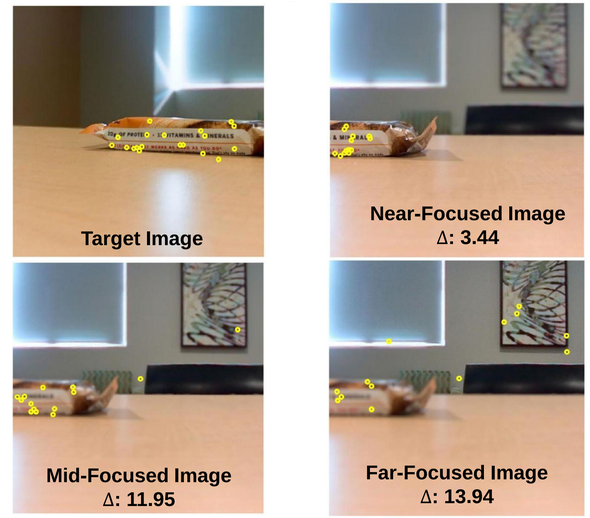
Reference

[1] Yang, Jason C., et al. "A Real-Time Distributed Light Field Camera."Rendering Techniques 2002 (2002): 77-86.
[2] Ng, Ren, et al. "Light field photography with a hand-held plenoptic camera."Computer Science Technical Report CSTR 2.11 (2005): 1-11.
[3] D. G. Dansereau, "Plenoptic signal processing for robust vision in field robotics," Ph.D. dissertation, Australian Centre for Field Robotics, School of Aerospace, Mechanical and Mechatronic Engineering, The University of Sydney, Jan. 2014.
[4] Kim, Changil, et al. "Scene reconstruction from high spatio-angular resolution light fields." ACM Trans. Graph. 32.4 (2013): 73-1.

Depth Map



Stitching by Focal Stack

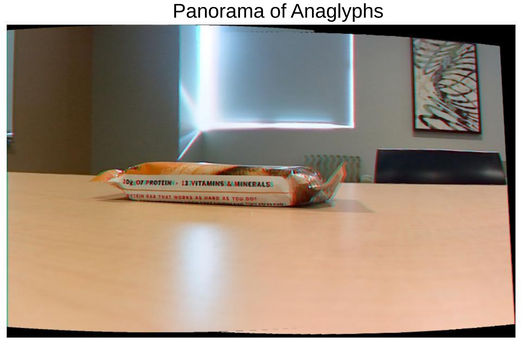


Images are stitched with information from focal stack. Left top: the target image. Right top: a near-focused image. Left bottom: a mid-focused image. Right bottom: a far-focused image. The yellow circles represent features detected by SIFT.

We calculate the difference between standard deviation in region around one SIFT feature of target and image to stitch, and then sum these differences up to obtain Δ. I.e. $\Delta = \sum_{features} |std_1 - std_2| / std_1$. We choose the picture with smallest Δ to stitch. (In this example is the near-focused one)

Panorama

Panorama of Anaglyphs



Here we present the near-focused (left top), far-focused (left bottom) and anaglyphs panorama (right top) generated from light field images.