Hacking a Consumer DSLR Lens for Computational Imaging

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Motivation

With modification, it is possible to externally control conventional and nonconventional actuators in consumer DSLR lenses. This enables computational imaging techniques possible with everyday hardware.

Project Description

Hardware:

Remote control of focus, lateral movement of the image stabilization element, and all camera settings.

Software:

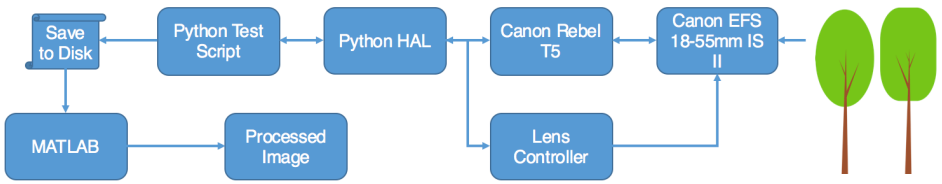
Python script for programmatically controlling all aspects of exposure. Demonstration of depth invariant capture, light field, and super resolution techniques.

Related Work

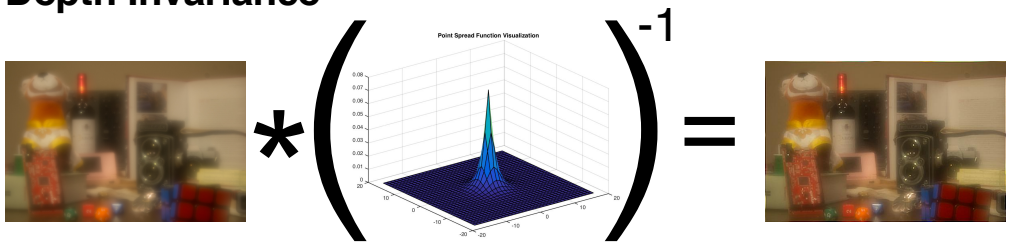
Focal sweep techniques with DSLRs were demonstrated by Bando, et al. in [1] and [2].

Repurposing the image stabilization system for lateral movement was shown by McClosckey, et al. in [3].

System Diagram



Depth Invariance



Scene with custom blur kernel

Deconvolution using ADMM + TV prior

Extended depth of field reconstruction

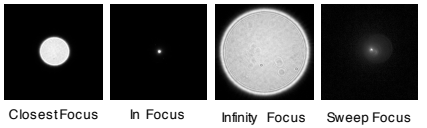
Super Resolution

Scene for super resolution

Scene detail

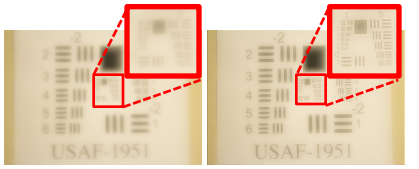
Super resolved detail

Experimental Results



Closest Focus | In Focus | Infinity Focus | Sweep Focus

Measured point spread function



Focal Sweep Image | Deconvolved, PSNR: 16.97

Focal sweep deconvolution

Original Detail | Super Resolved Detail

Super-resolution extreme crop

Acknowledgments

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[1] Y. Bando, et al. "Near-invariant blur for depth and 2D motion via time-varying light field analysis." *ACM Trans. Graph.* 32, 2013. [2] Y. Bando, "An Analysis of Focus Sweep for Improved 2D Motion Invariance," *2013 IEEE Conf. on Computer Vision and Pattern Recognition*, Portland, OR, 2013. [3] S. McCloskey, et al. "Motion invariance and custom blur from lens motion," *2011 IEEE Int'l Conf. on Computational Photography (ICCP)*, Pittsburgh, PA, 2011, pp. 1-8.