

Capturing light fields using spherical mirrors

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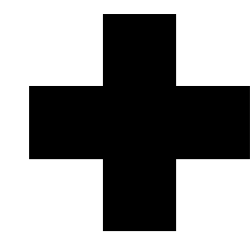
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Motivation

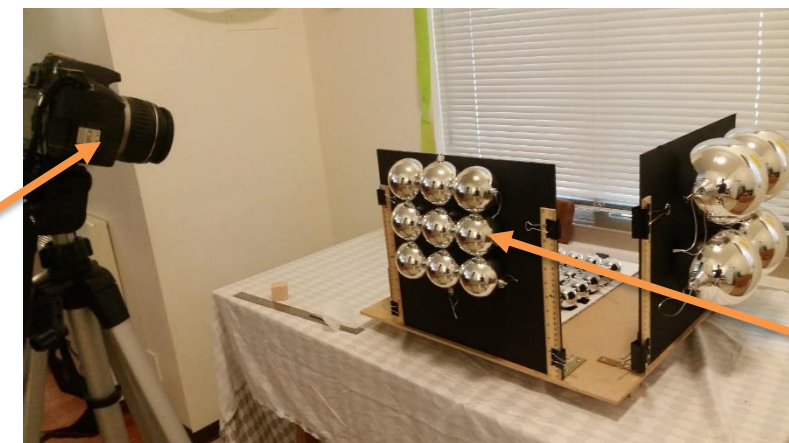
Camera arrays for
Light Field capture



Wide FOV
Lighting Probes



Computationally
reconstruct Light
Field from a single
camera image



The prototype system consists of Christmas balls mounted to a foam board. The board is supported on a firm plywood base

Spherical mirror array serving as a set of virtual cameras

Uses only Single
Camera

Wide Field of view

Low Cost

No Camera
Modification

Spatio-Angular
Tradeoff

Scene Dependent
Calibration

Technique

Capture Single Shot of
the spherical mirror
array

Represent the image
using a set of virtual
perspective cameras

Projective texture
mapping onto the
required focal surface
and recover light field

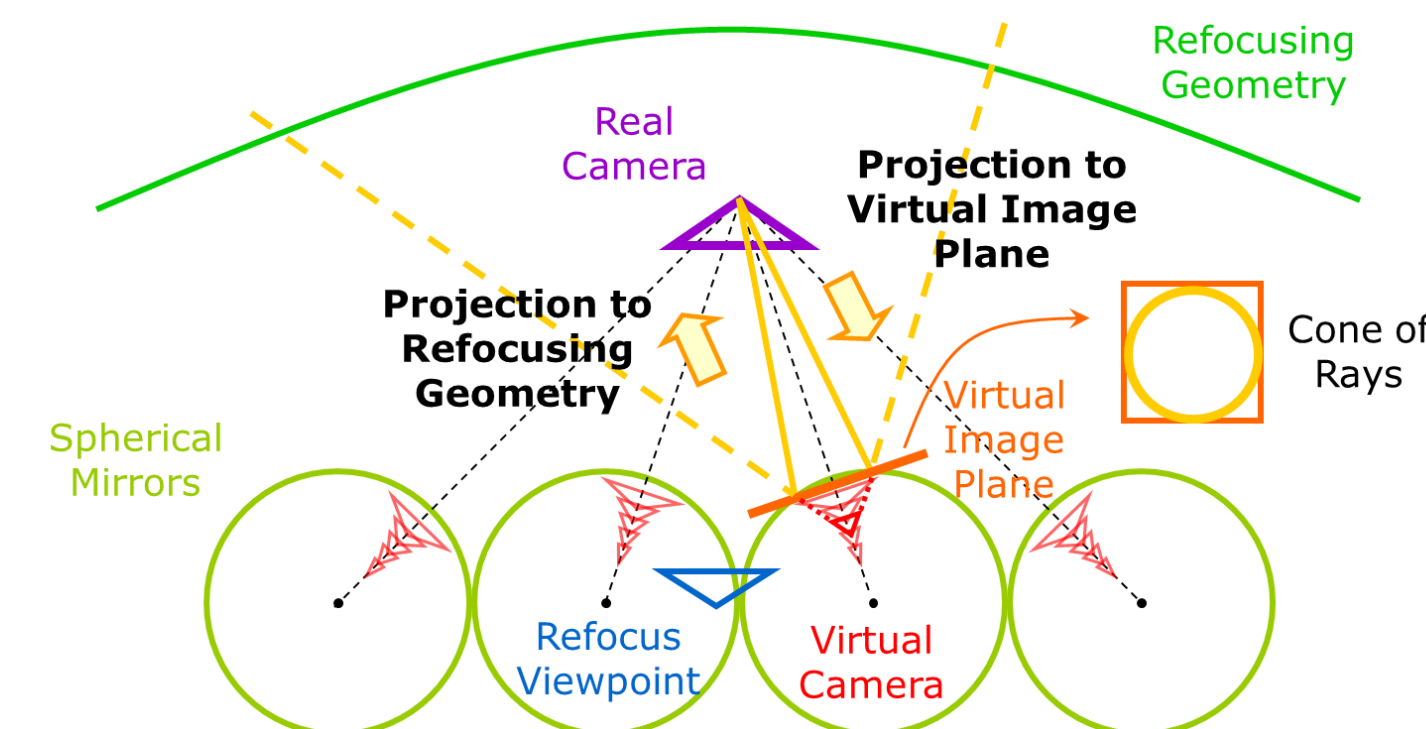
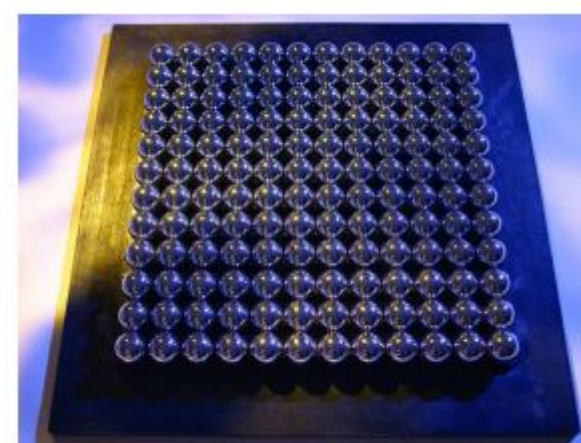


Image from : Taguchi, Yuichi, et al. *ACM Trans. Graph.* 29.6 (2010): 172.

- Implemented Axial cone modeling and refocusing in MATLAB/C++
- Requires Calibration of camera position once on setup
- Surface imperfections in the Christmas balls resulting in a very blurry image
- Spatio-angular resolution trade-off
- Lower resolution in peripheral region
- Better Quality image with larger balls, but lower light field sampling
- Better results can be obtained using stainless steel balls (not used here due to the cost)

Related Work

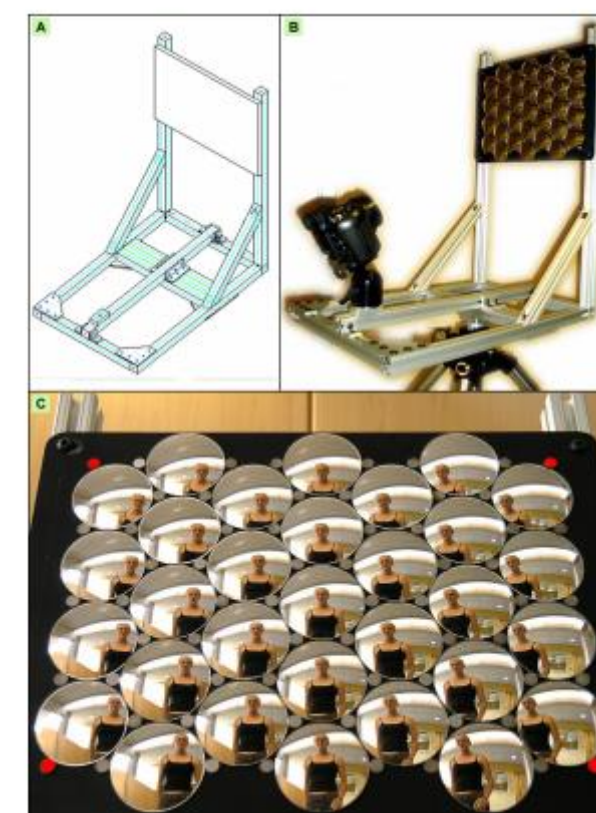
- Catadioptric Imaging System(CIS) is a well studied branch in literature, which comprises of camera systems consisting on mirrors and lenses for increasing the effective field of view.
- A number of studies which uses spherical mirrors used as lighting probes for image based lighting or as multi perspective cameras for triangulation. 3D reconstruction and construction light fields



Unger, Jonas, et al. *Capturing and rendering with incident light fields.* UNIVERSITY OF SOUTHERN CALIFORNIA MARINA DEL REY CA INST FOR CREATIVE TECHNOLOGIES, 2003.



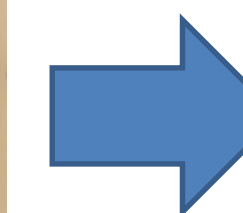
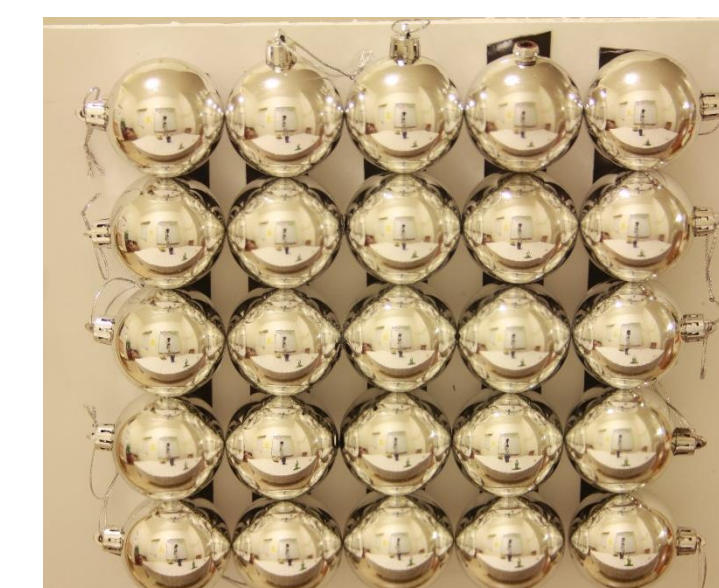
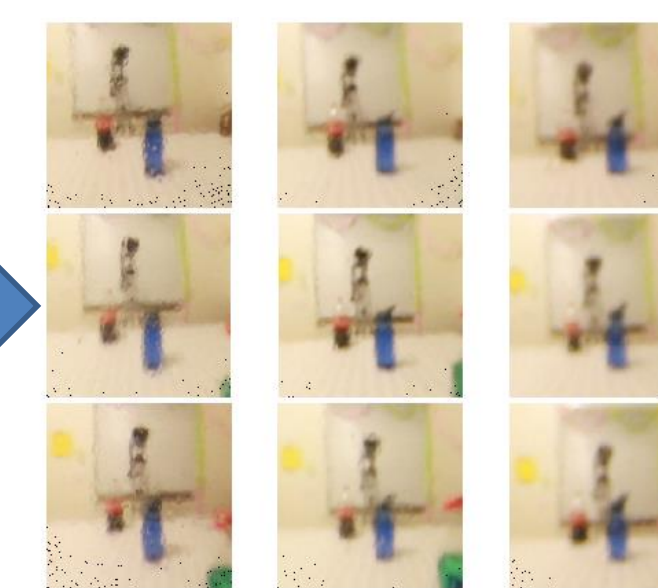
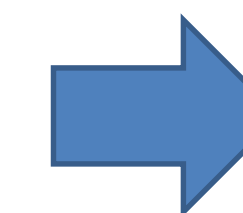
Taguchi, Yuichi, et al. "Axial light field for curved mirrors: Reflect your perspective, widen your view." *Computer Vision and Pattern Recognition (CVPR), 2010 IEEE Conference on.* IEEE, 2010..



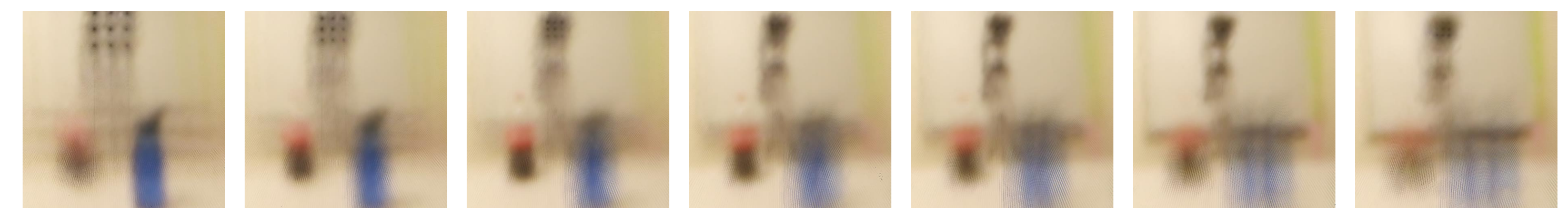
Lanman, Douglas, et al. "3D Data Processing, Visualization, and Transmission, Third International Symposium on." IEEE, 2006.

Experimental Results

Light Field



Refocus



Digital refocusing from front to back (3x3 array). Note how the bottle gets out of focus and the camera gets in focus