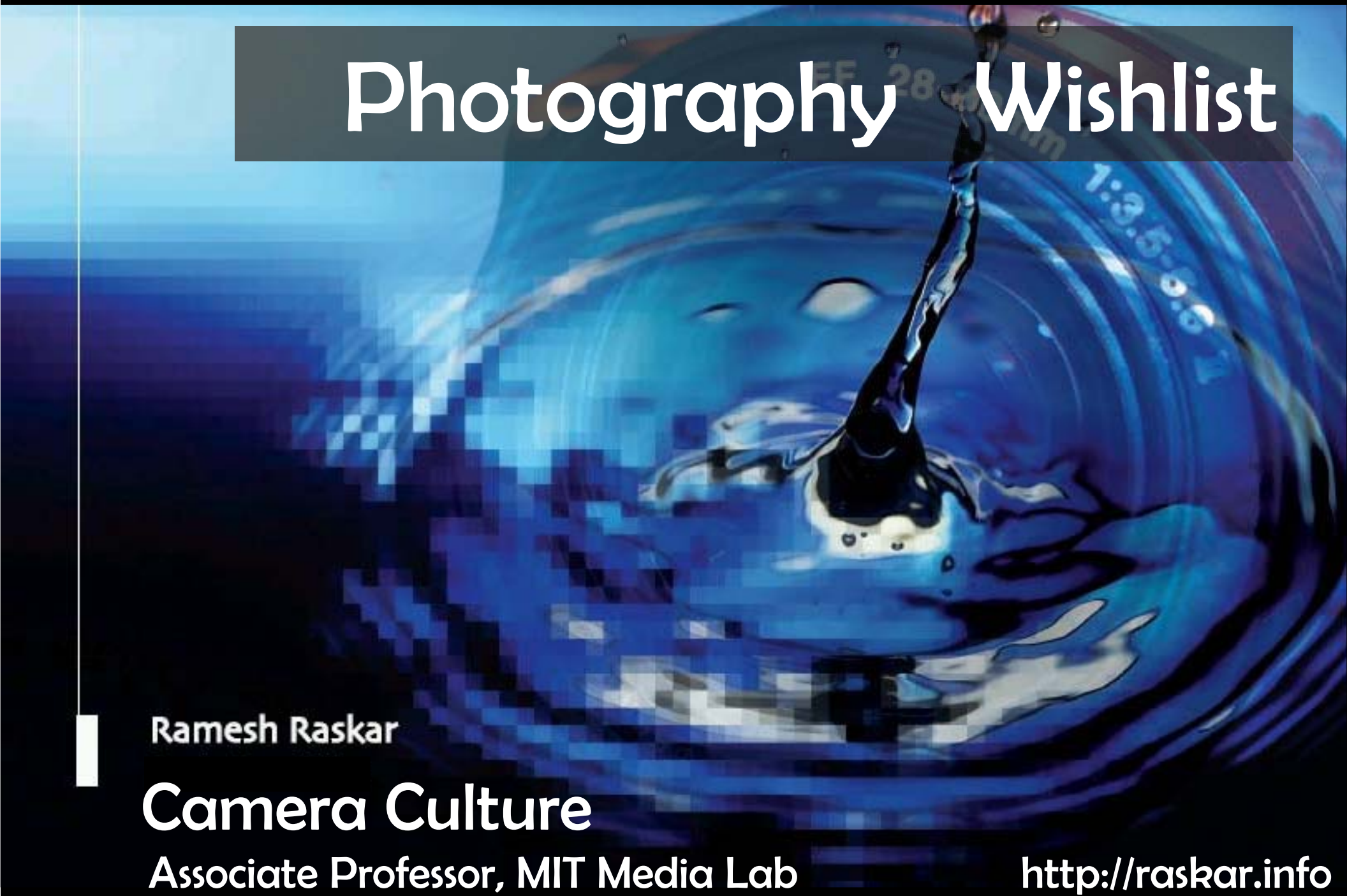
Photography Wishlist



Ramesh Raskar

Camera Culture

Associate Professor, MIT Media Lab

http://raskar.info

Images removed due to copyright restrictions.
Early digital cameras: Kodak DCS 400 series electronics on Nikon SLR body.
See http://en.wikipedia.org/wiki/Kodak_DCS_400_series

Film-like Digital Photography

Shadow Refractive Reflective

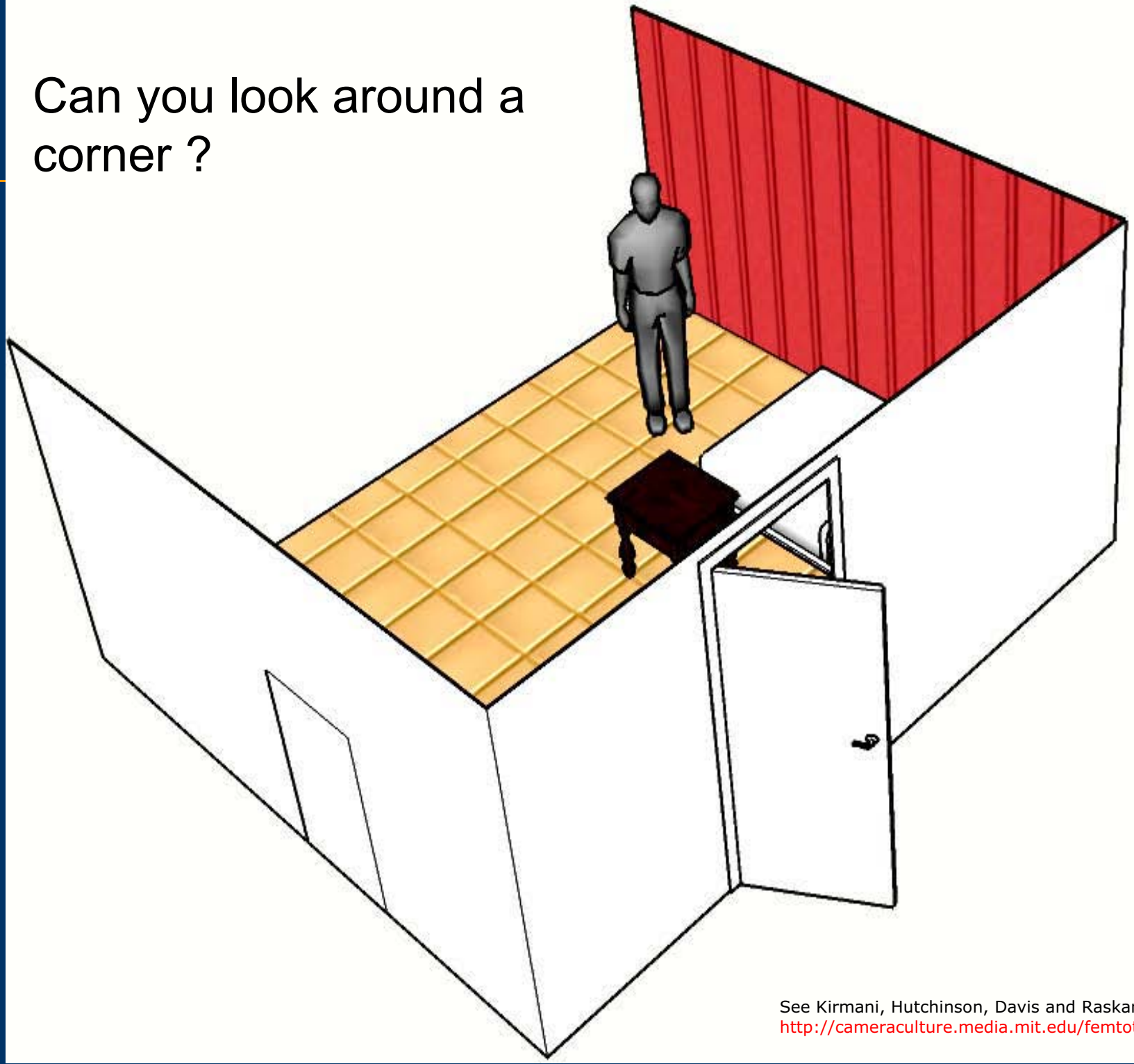
Image removed due to copyright restrictions.
See Fig. 1, “Eight major types of optics in animal eyes.”
In Fernald, R. D. “Casting a Genetic Light on the Evolution of Eyes.”
Science 313, no. 5795 (29 September 2006): 1914-1918.

Fernald, Science [Sept 2006]

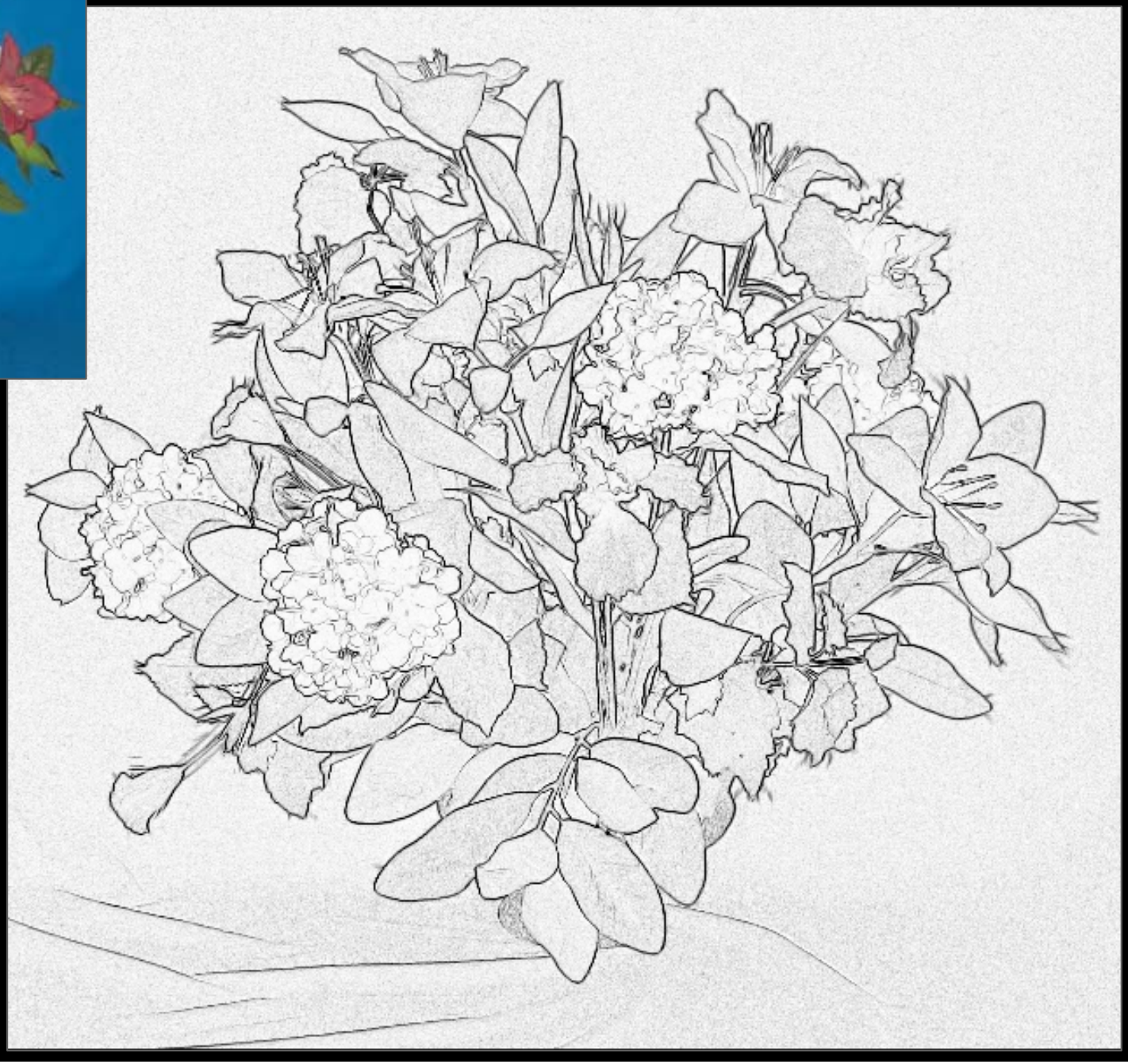
Wish List Today

- Consumers
  - Super-human vision
  - Microscope like resolution
  - High speed
  - See inside the body (health)
  - Auto-trigger
  - Keep only ‘good’ pics
  - Find ‘relevant’ pics and better archiving/access
  - Put photographer back in photo!
- Companies
  - Cost
  - Resolution
  - Low-light sensitivity, HDR
  - Stereo and 3D
  - Mecha-free zoom/focus
  - Auto-tagging for sharing
  - Recognition

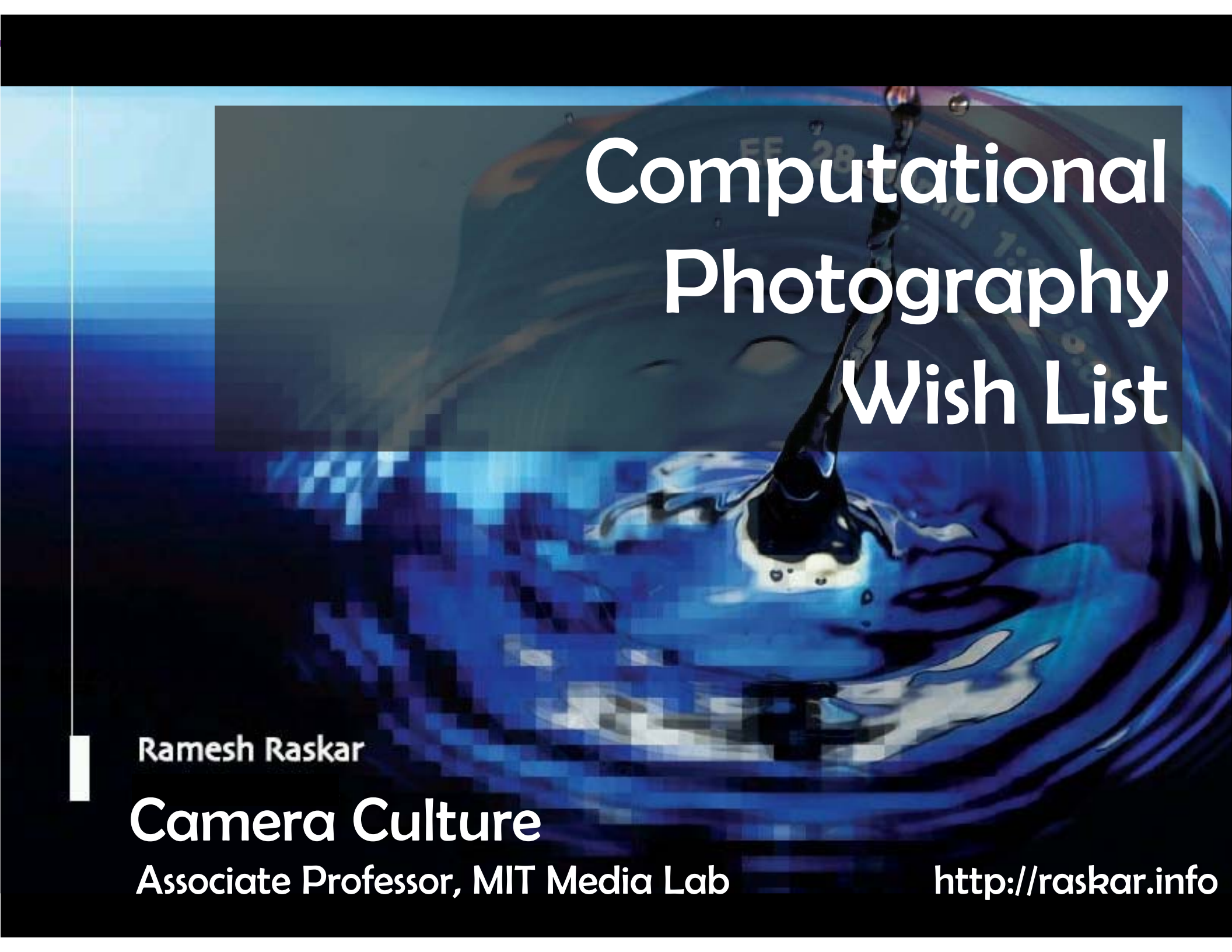
Can you look around a corner ?



See Kirmani, Hutchinson, Davis and Raskar, ICCV 2009 Oral presentation.
http://cameraculture.media.mit.edu/femtotransientimaging



Raskar, Tan, Feris, Yu and Turk.
SIGGRAPH 2004.
http://web.media.mit.edu/~raskar/NprCamera



Computational Photography Wish List

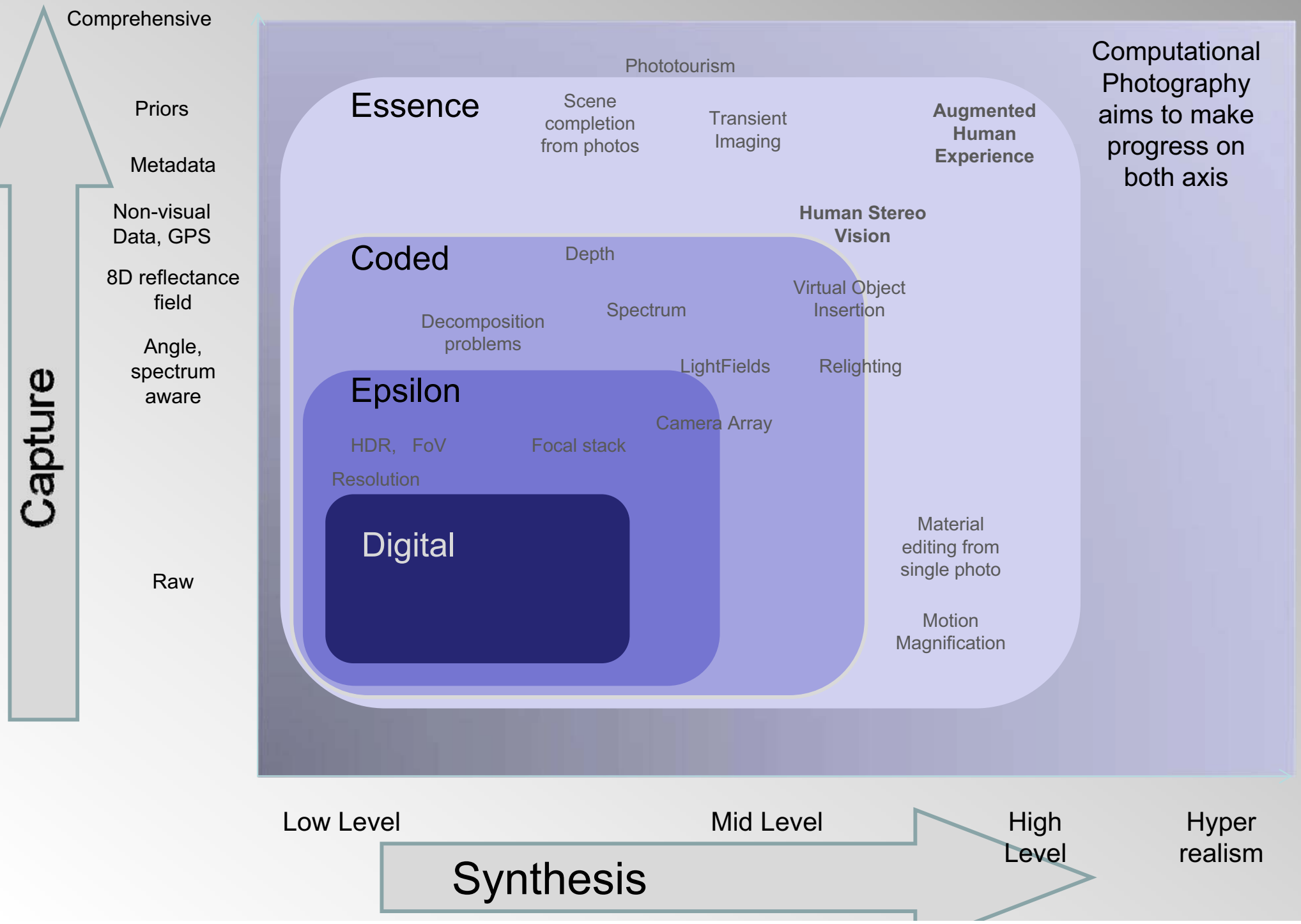
Ramesh Raskar

Camera Culture

Associate Professor, MIT Media Lab

http://raskar.info

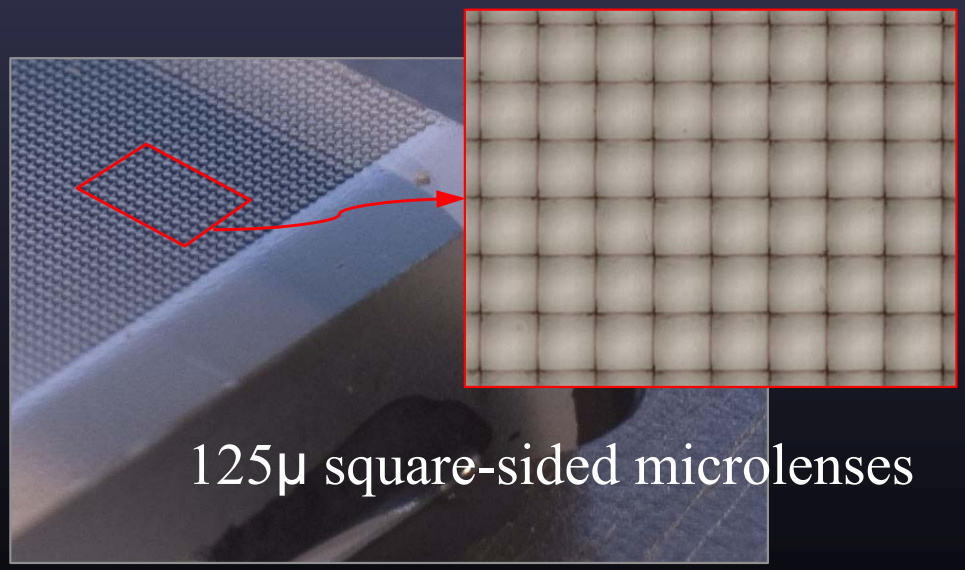
Computational Photography



Wish #1

Ultimate Post-capture Control

Digital Refocusing using Light Field Camera

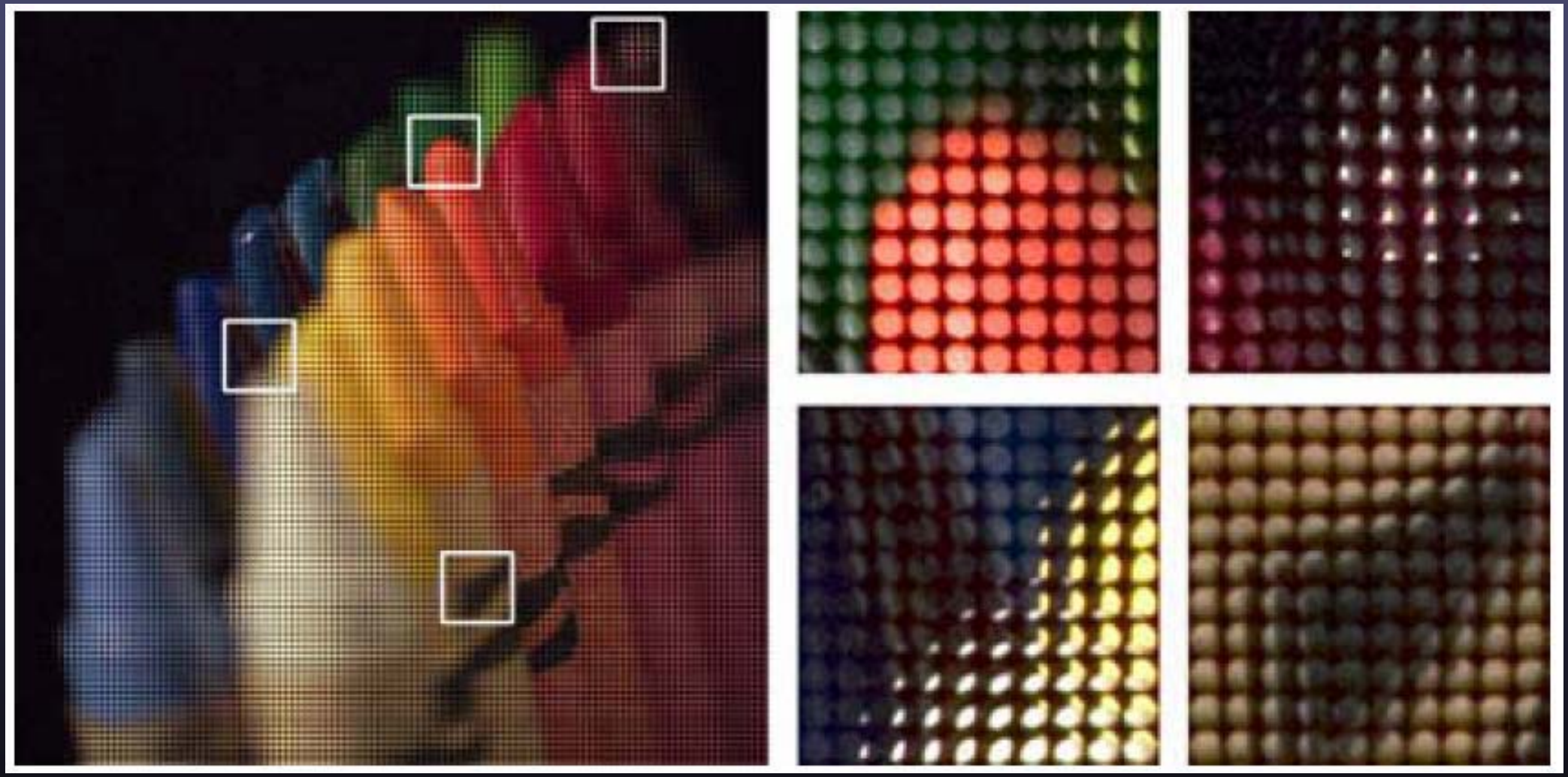


125μ square-sided microlenses

[Ng et al 2005]

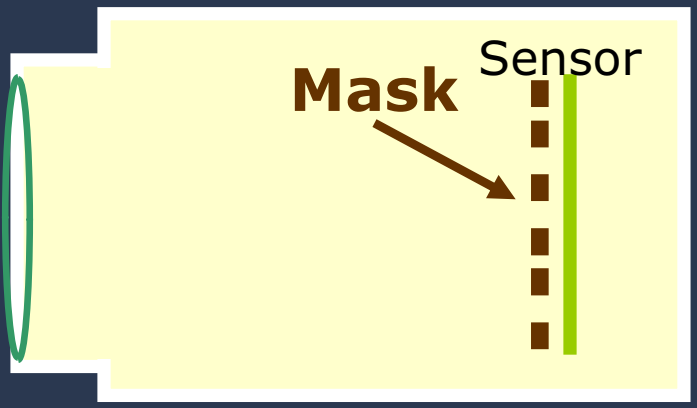
Courtesy of Ren Ng. Used with permission.

Zooming into the raw photo

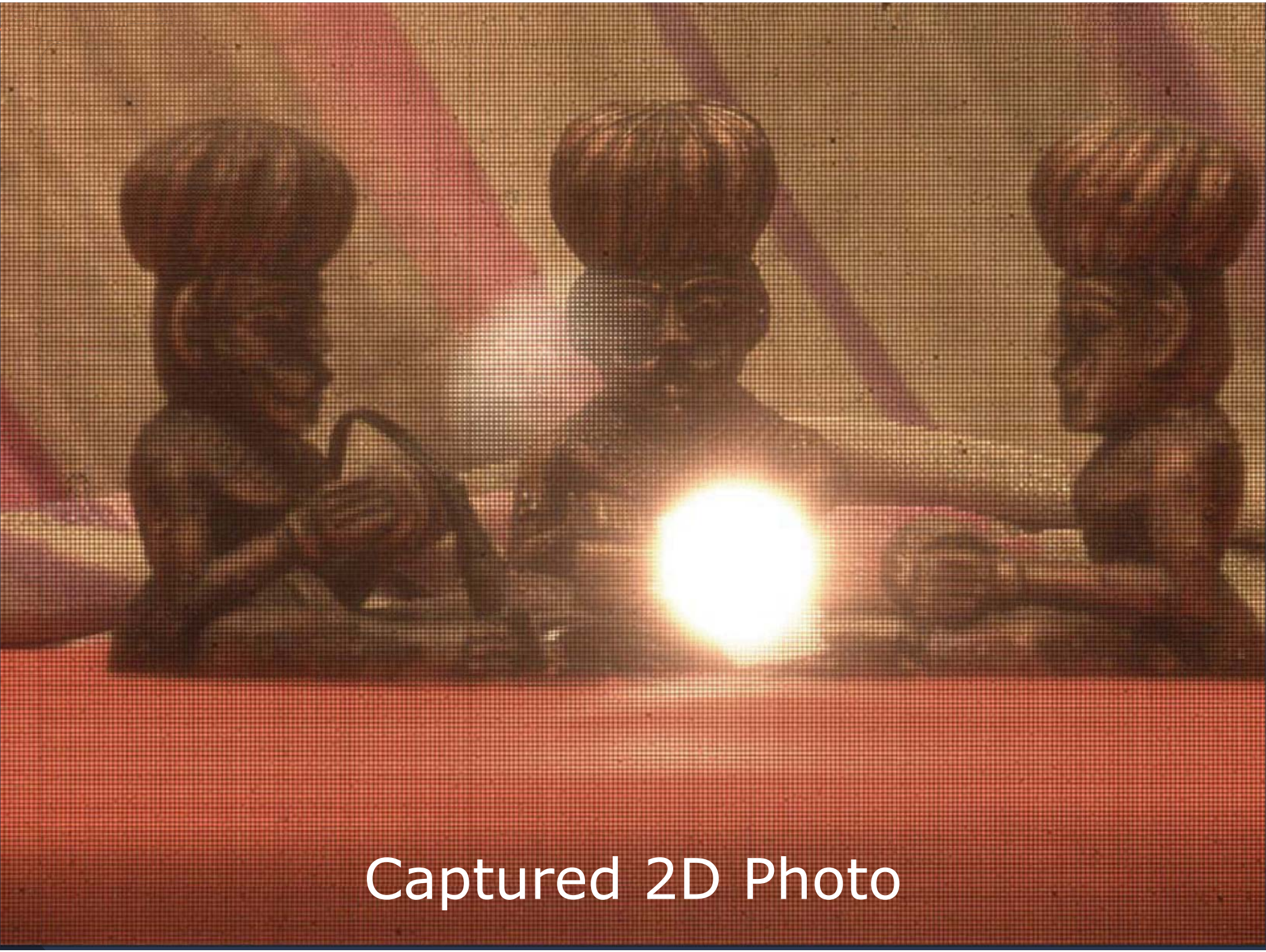


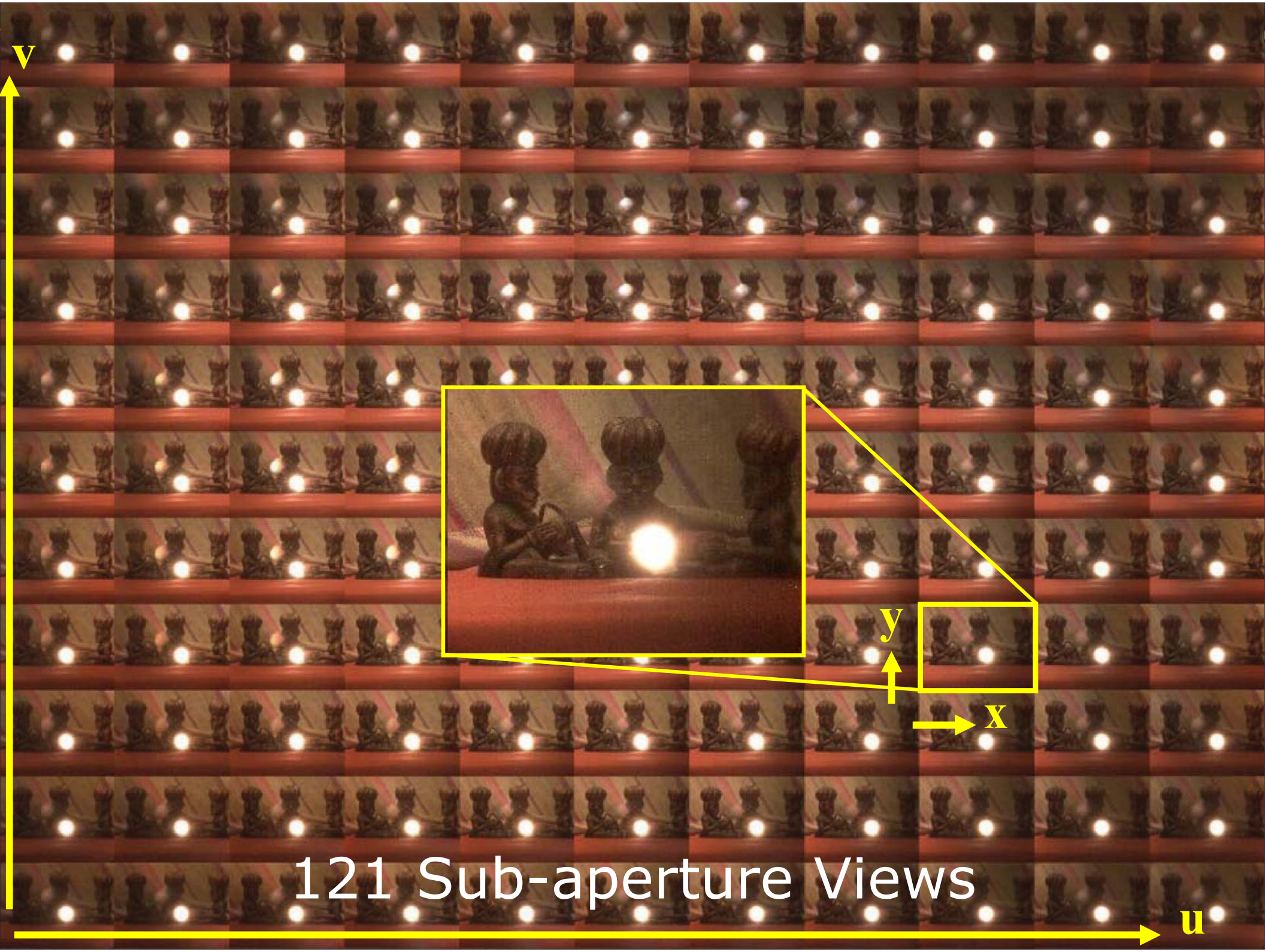
Courtesy of Ren Ng. Used with permission.

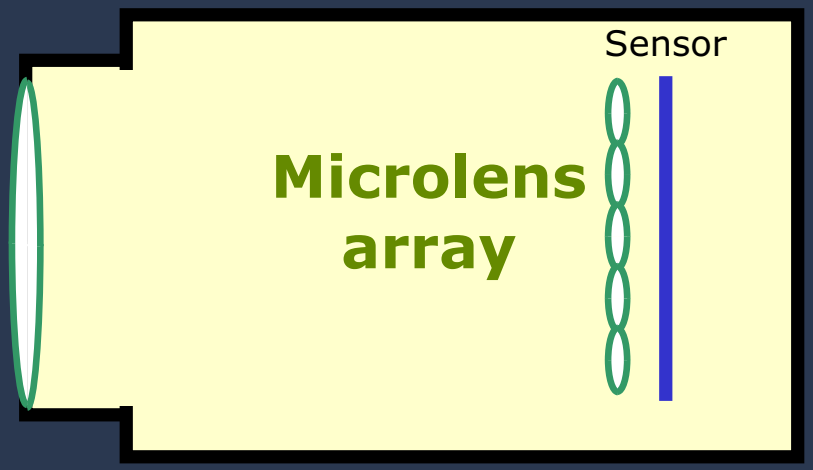
Mask based Light Field Camera



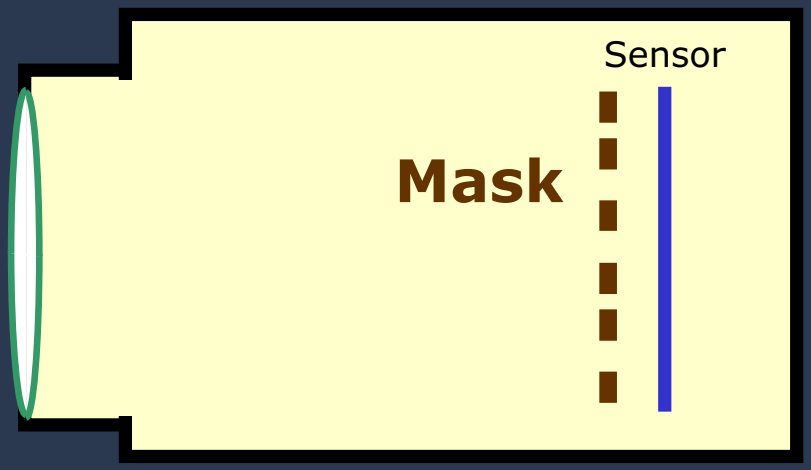
[Veeraraghavan, Raskar, Agrawal, Tumblin, Mohan, Siggraph 2007]


Captured 2D Photo


v
y
x
121 Sub-aperture Views
u



Plenoptic Camera



Heterodyne Camera

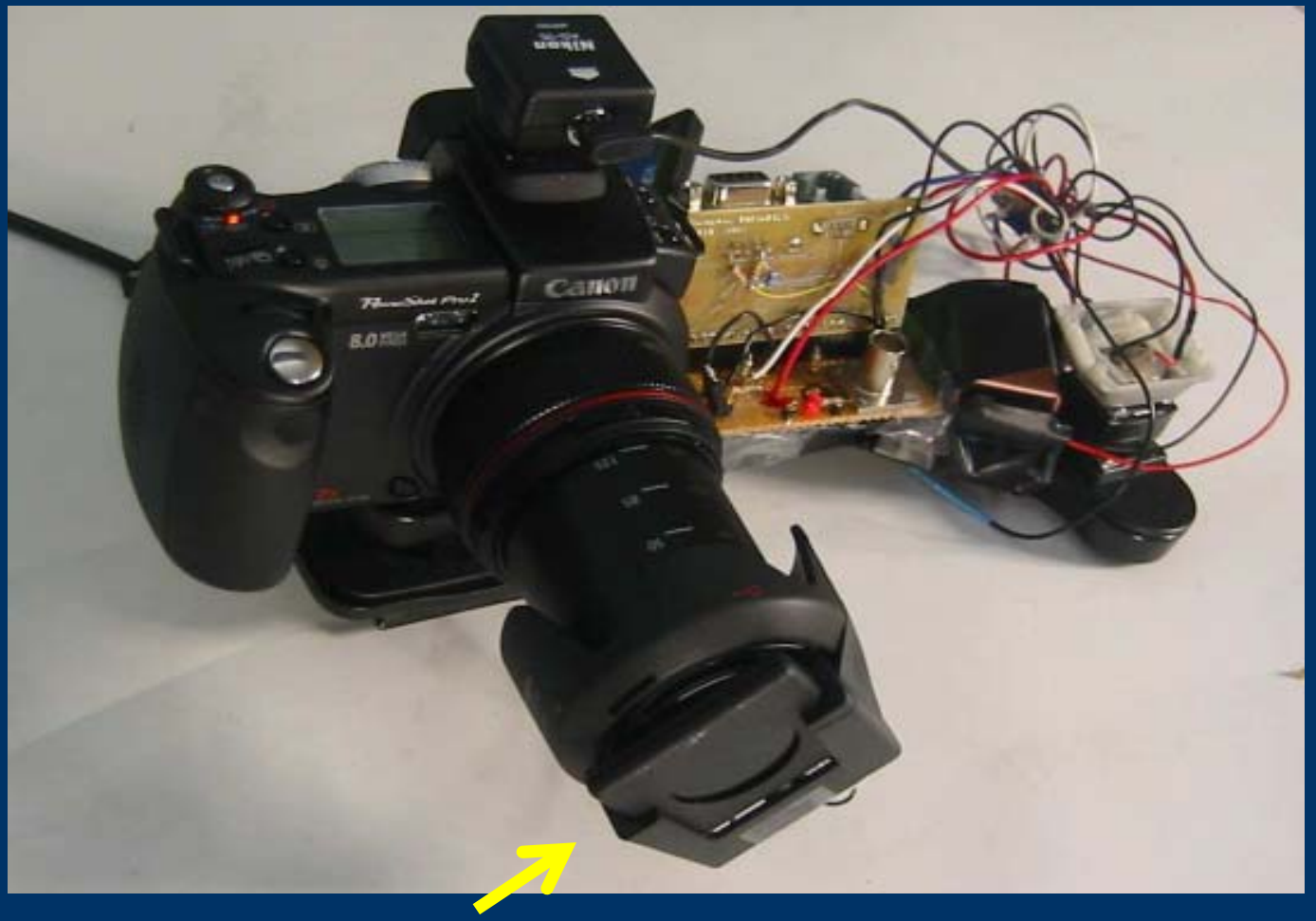
- Samples individual rays
- Predefined spectrum for lenses
- Chromatic abberration
- High alignment precision
- For each lenslet, peripheral pixels are wasted
- Negligible Light Loss

- Samples coded combination of rays
- Supports any wavelength
- Reconfigurable f/#, Easier alignment
- No wastage
- High resolution image for parts of scene in focus
- 50 % Light Loss due to mask

Motion Blur in Low Light

Fluttered Shutter Camera

Raskar, Agrawal, Tumblin Siggraph2006



Ferroelectric shutter in front of the lens is turned opaque or transparent in a rapid binary sequence

Motion Blur in Low Light

Courtesy of cromacom on Flickr.

Courtesy of haraldwalker on Flickr.

Compact Programmable Lights ?

Wish #1

Ultimate Post-capture Control

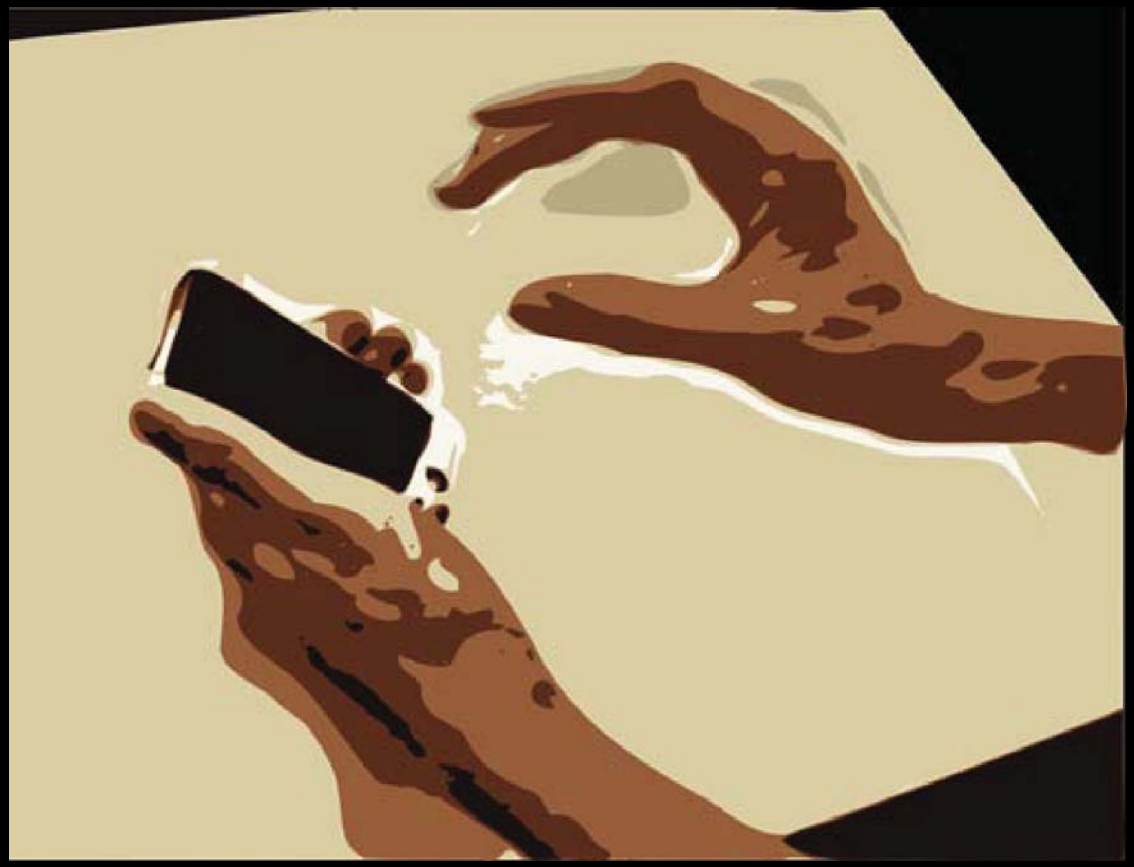
- Digital Refocus and Motion blur
- Emulate studio light from compact flash

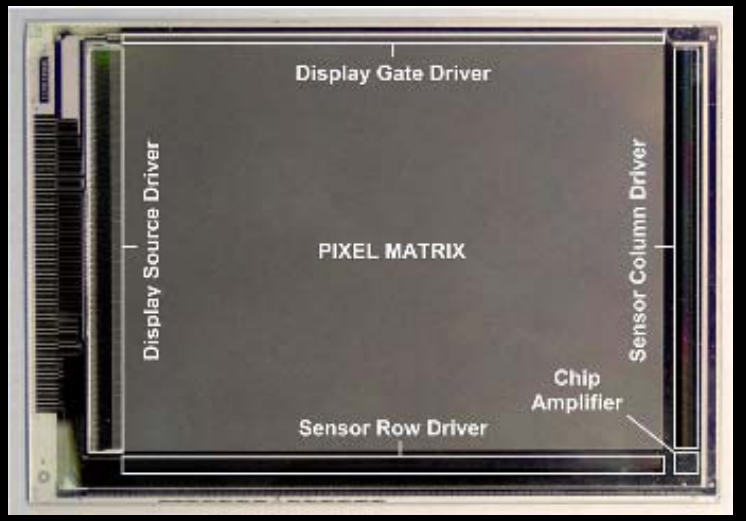
Wish #2

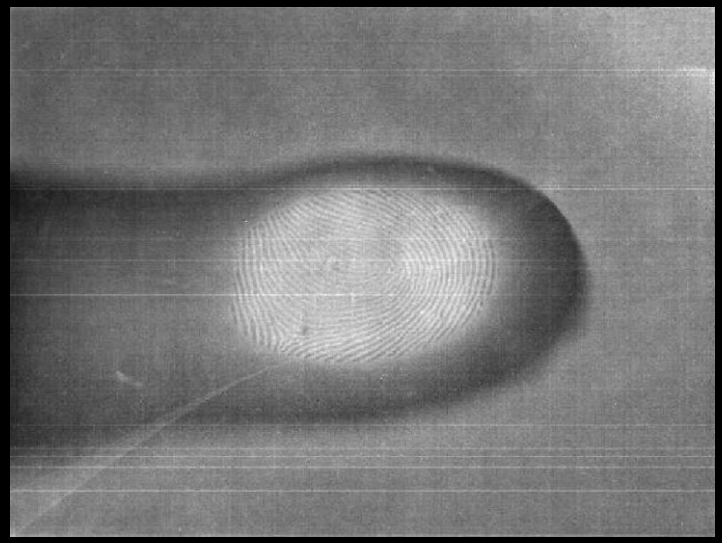
Freedom from Form

Convert LCD into a big flat camera?

Beyond Multi-touch: 3D Gestures



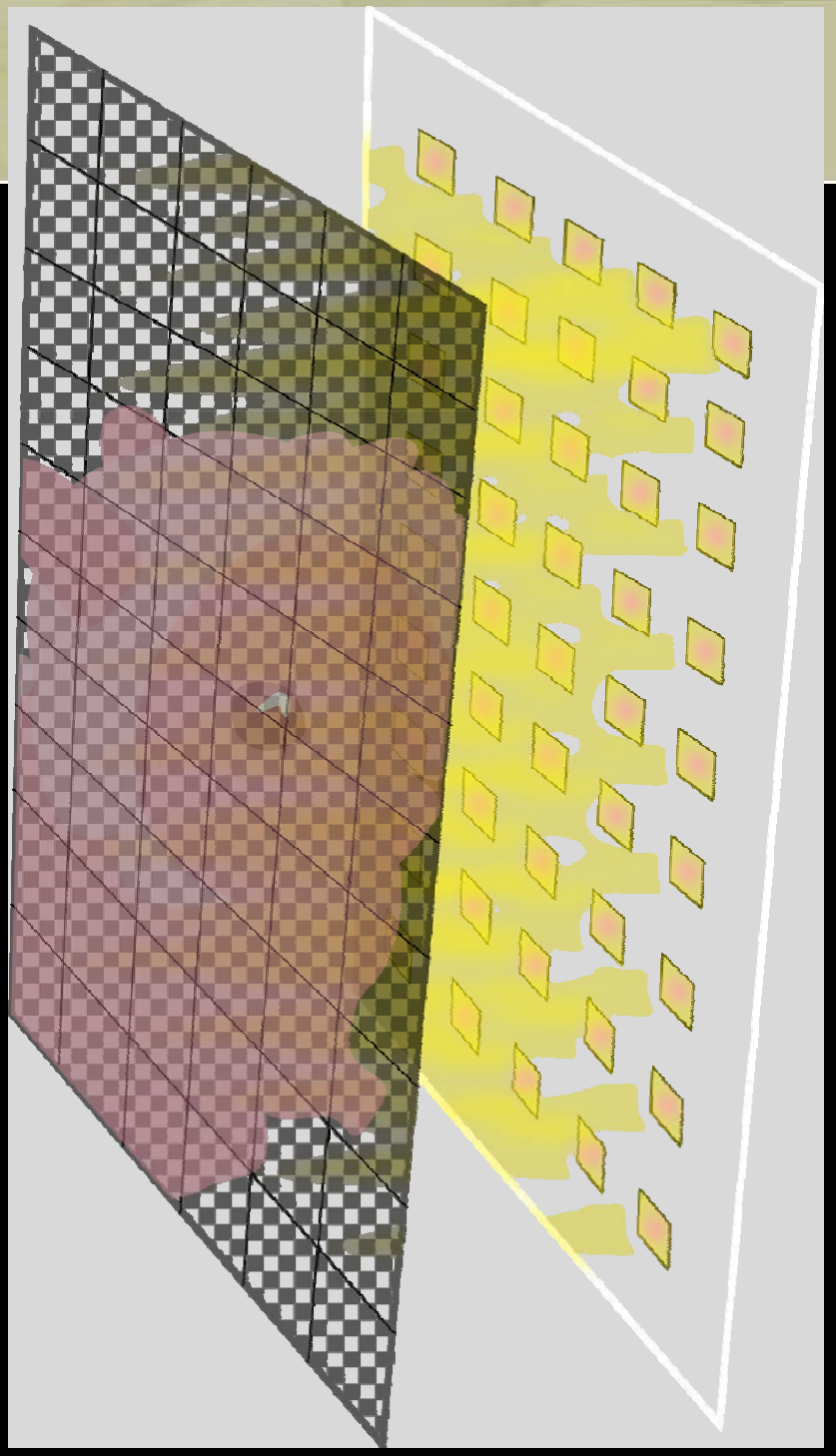




Courtesy of Matt Hirsch. Used with permission.

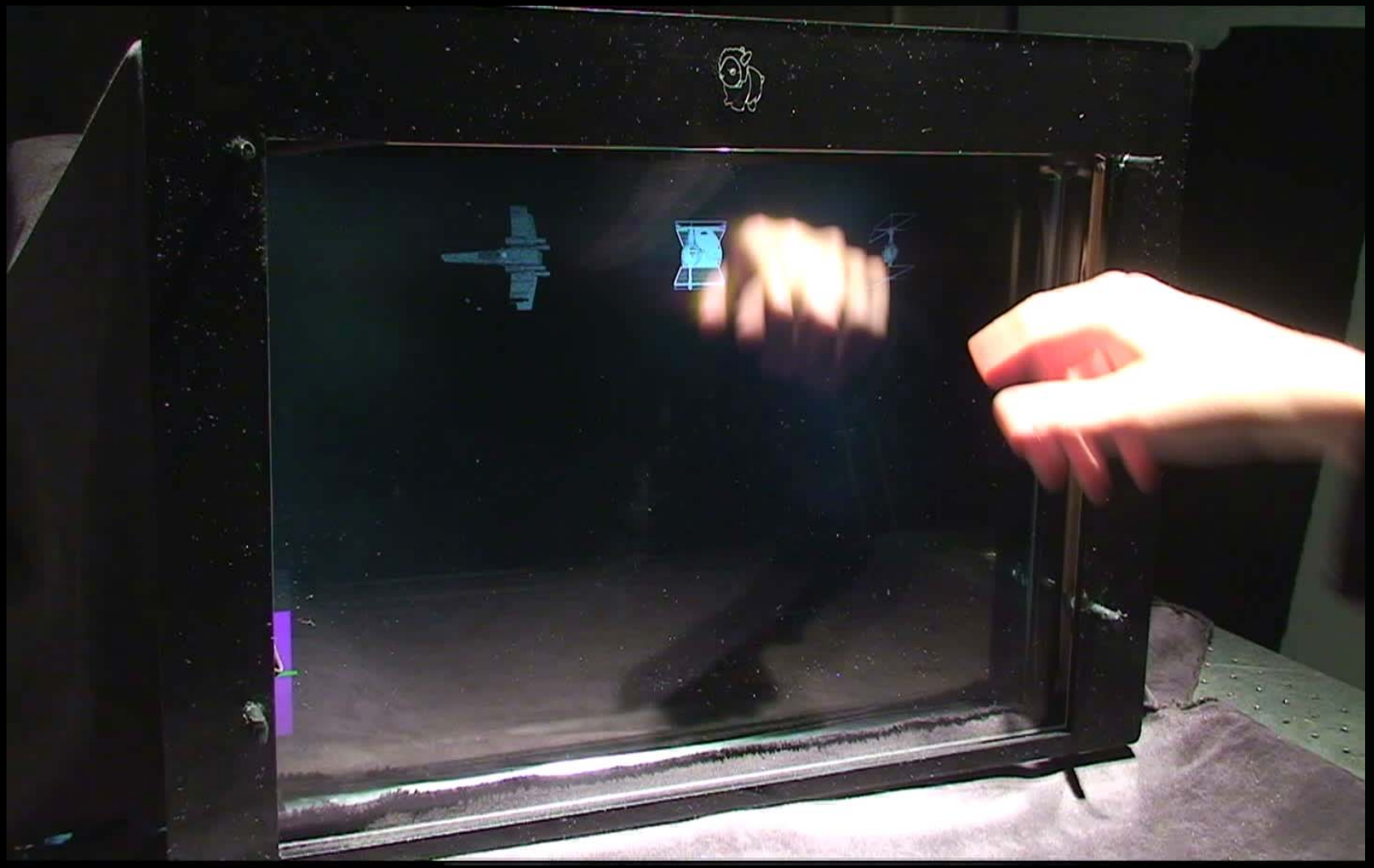
BiDi Screen

Large Virtual Camera for 3D Interactive HCI and Video Conferencing



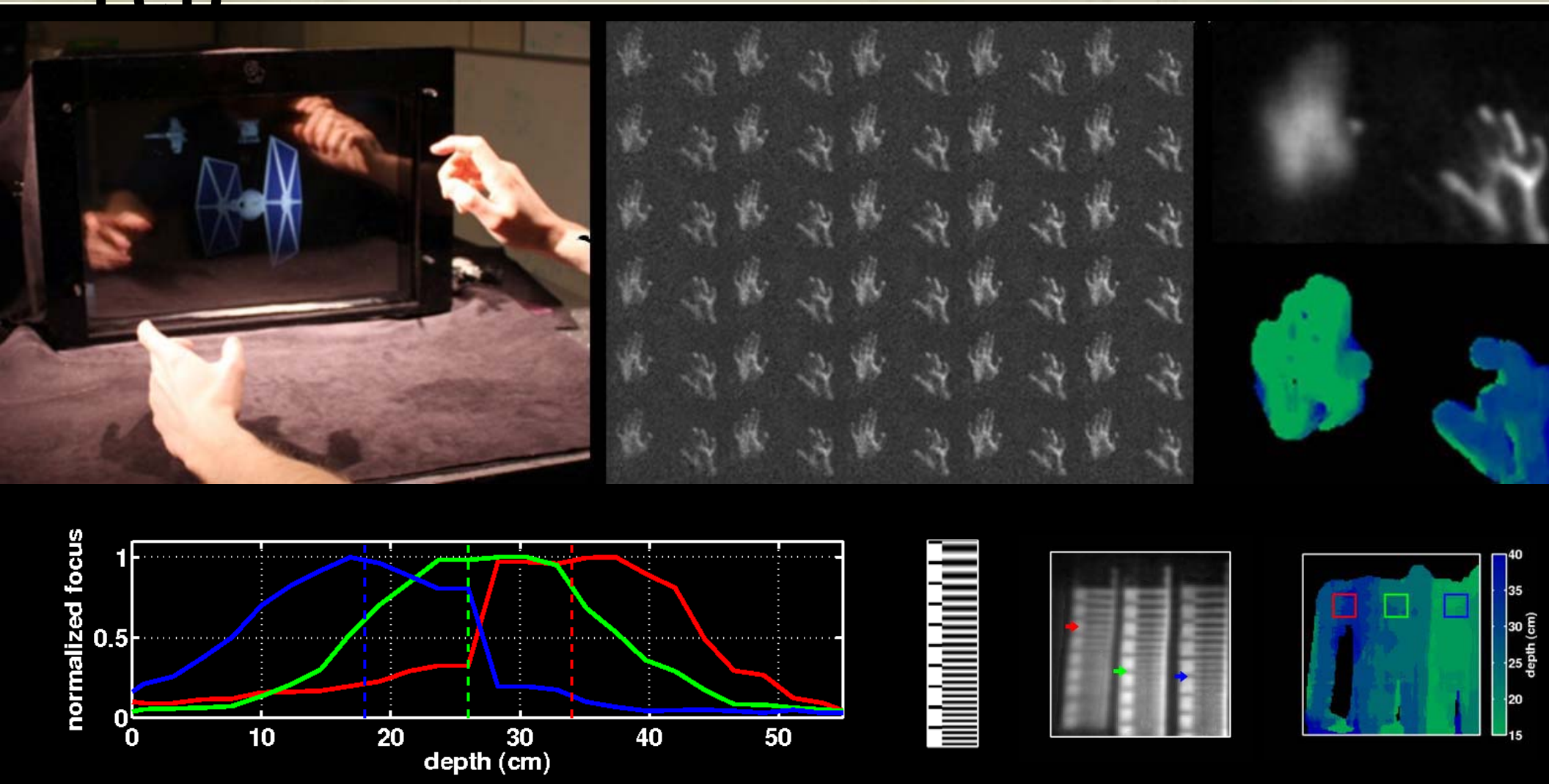
Matthew Hirsch, Henry Holtzman
Doug Lanman, Ramesh Raskar
Siggraph Asia 2009

Touch + Hover using Thin, Depth Sensing LCD Sensor



Courtesy of Matt Hirsch. Used with permission.

Sensing Depth from Array of Virtual Cameras in LCD



Courtesy of Matt Hirsch. Used with permission.

Shallow DoF with Simple Lens

Compact digital camera → Photo with large depth of field

SLR camera → Photo with narrow depth of field

Lots of glass; Heavy; Bulky; Expensive

Image Destabilization

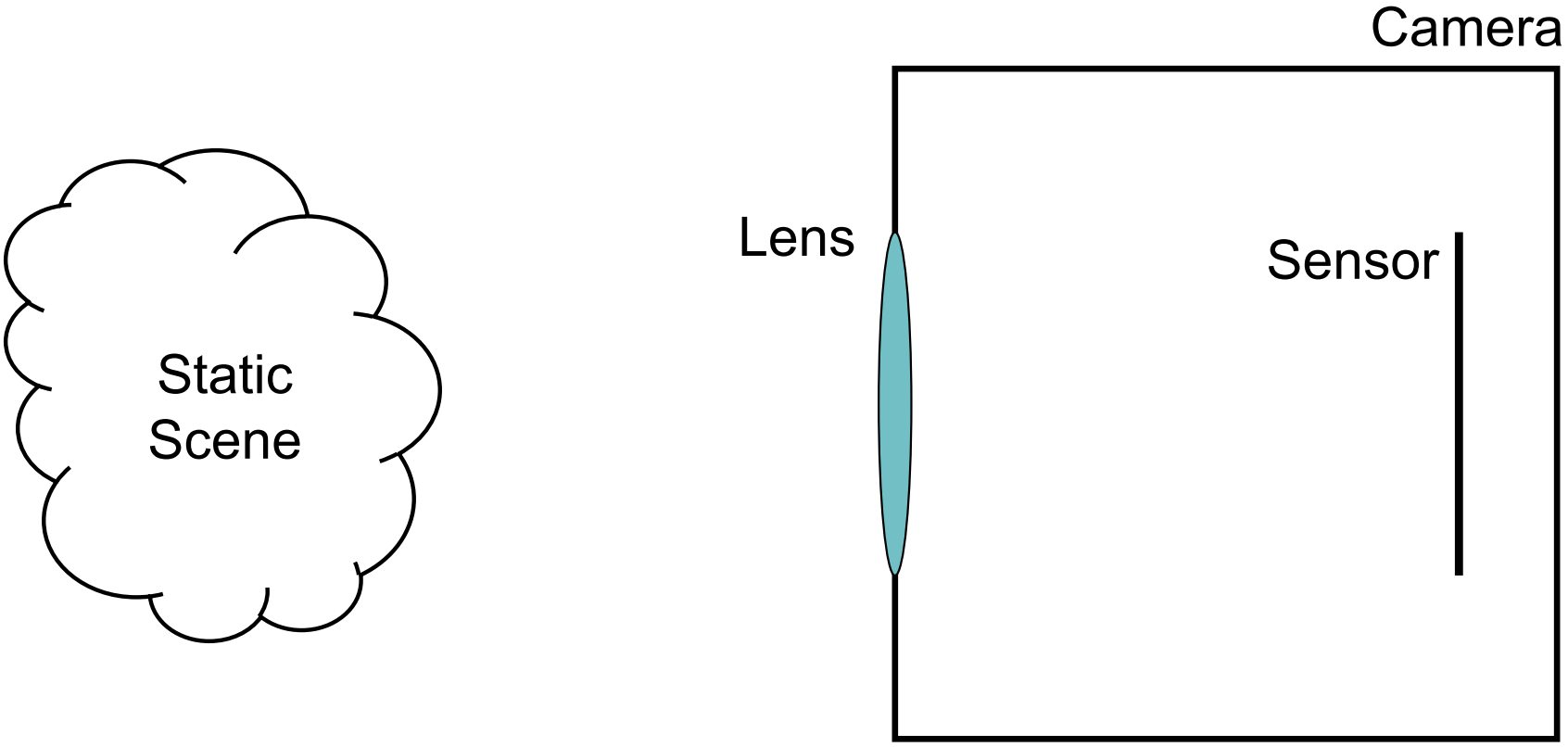
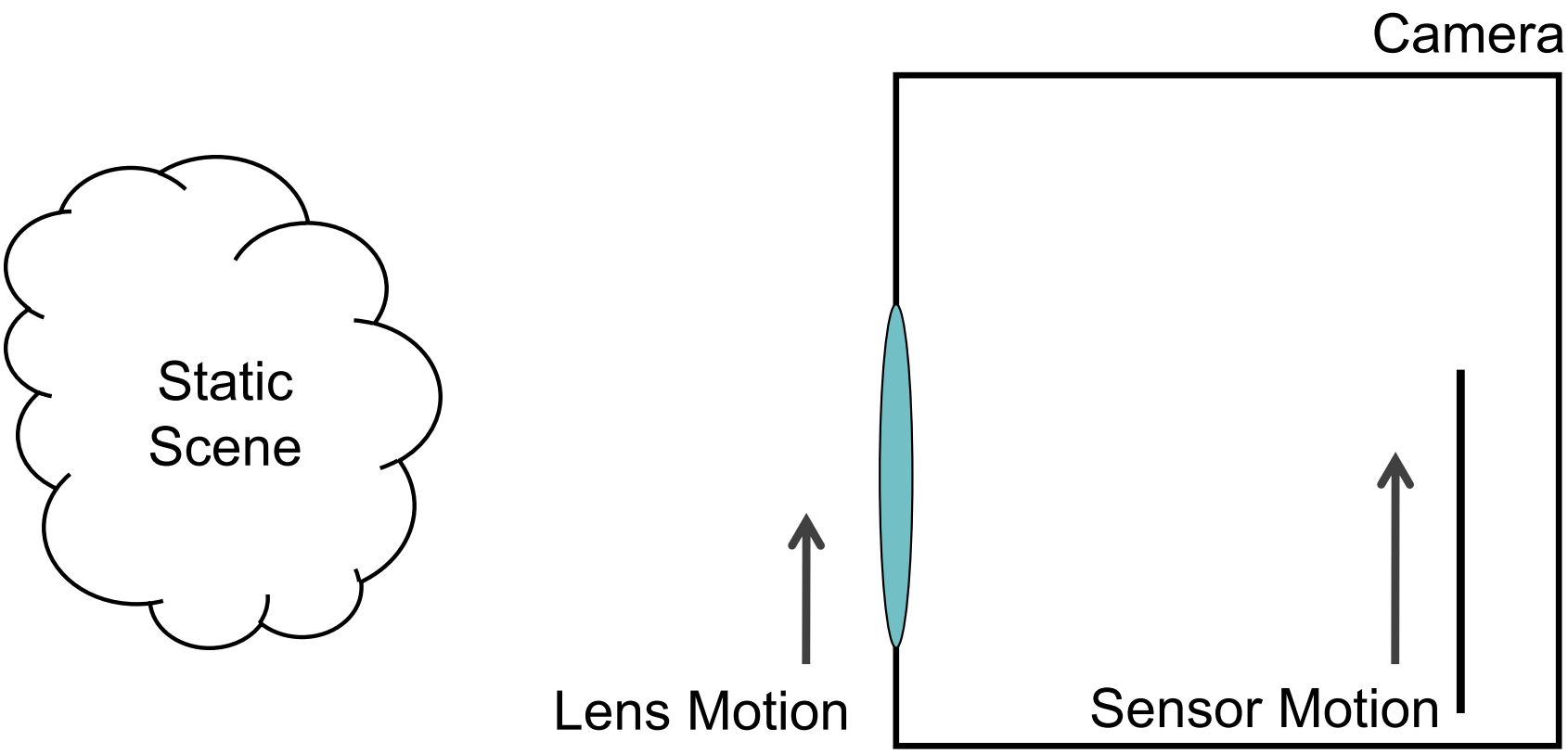


Image Destabilization



Mohan, Lanman,Hiura, Raskar ICCP 2009

Small Aperture Photo

all-in-focus

Destabilized Small Aperture

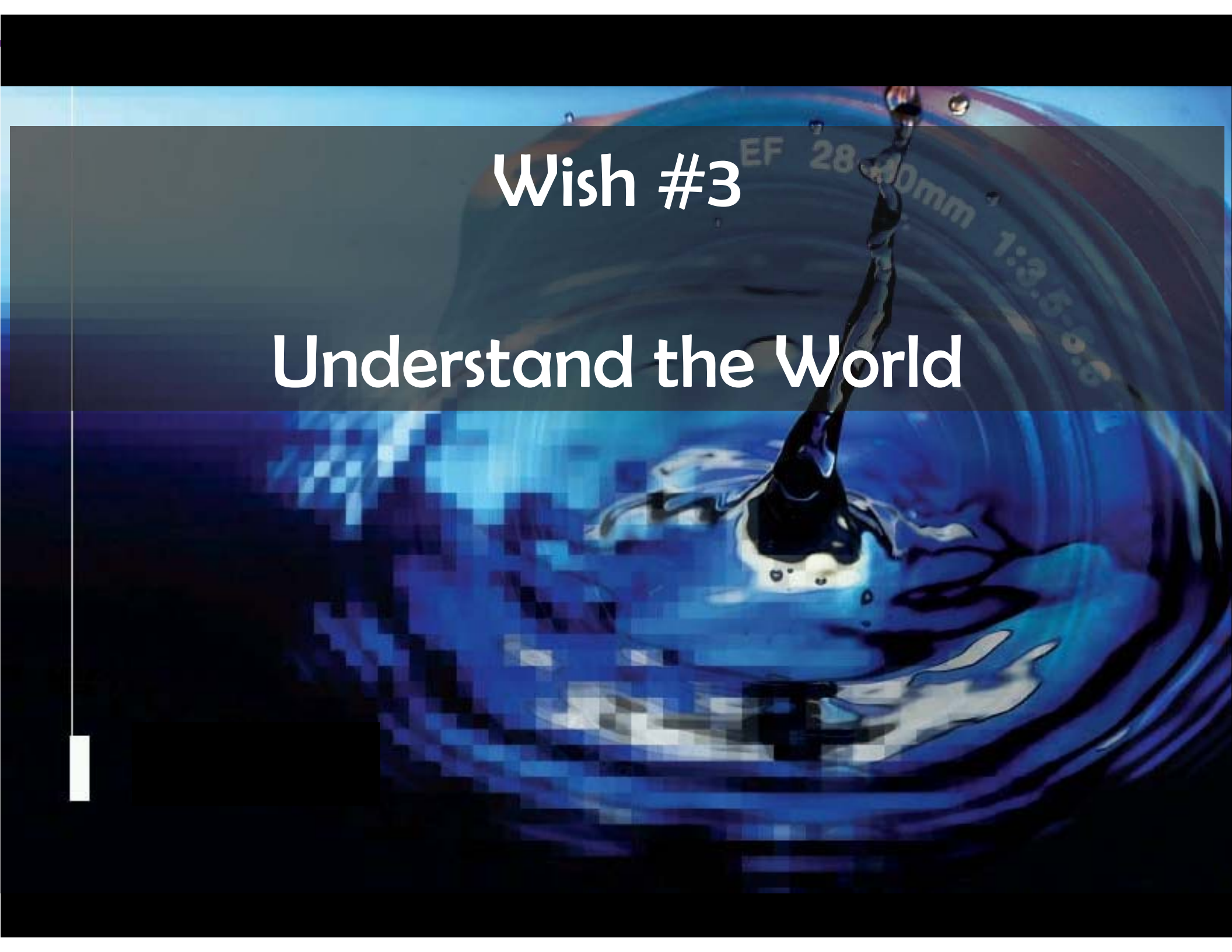
focused in the front using destabilization

Adjusting the Focus Plane

focused in the middle using destabilization

Adjusting the Focus Plane

focused in the back using destabilization



Wish #3

Understand the World

Convert single 2D photo into 3D ?

Snavely, Seitz, Szeliski
U of Washington/Microsoft: Photosynth

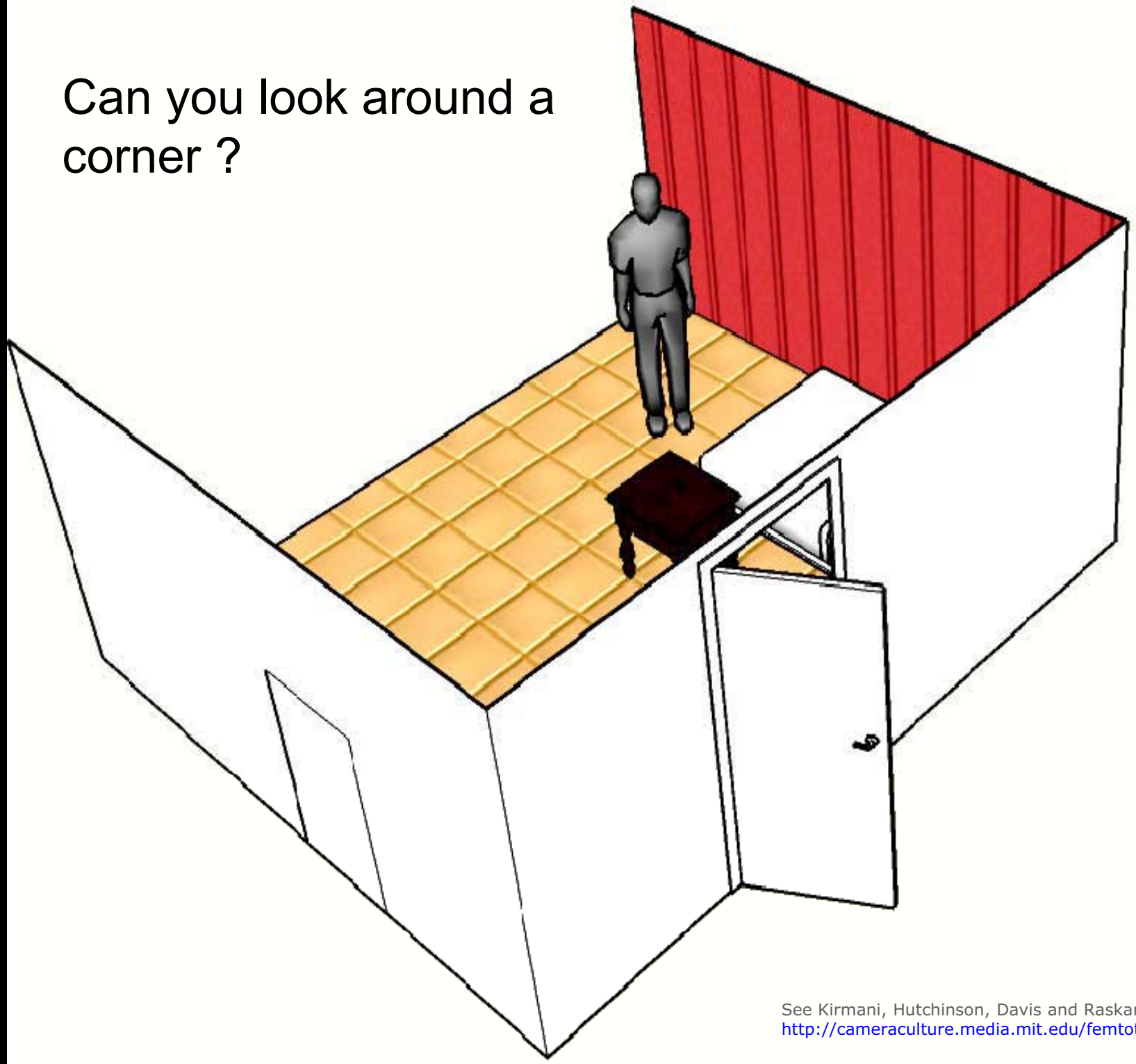
Images removed due to copyright restrictions.

Exploit Community Photo Collections

U of Washington/Microsoft: Photosynth

Images removed due to copyright restrictions.

Can you look around a corner ?



See Kirmani, Hutchinson, Davis and Raskar, ICCV 2009 Oral presentation.
http://cameraculture.media.mit.edu/femtotransientimaging

Femto-Photography:
Higher Dimensional Capture

FemtoFlash

UltraFast
Detector

Serious Sync

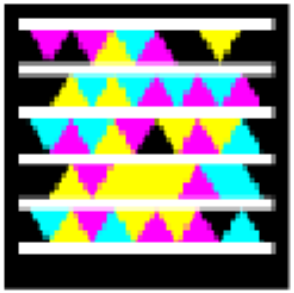
Computational Optics


Wo Studierende ihren Geist erfrischen:
NZZ-Studenten-Blogger berichten aus ihrem Alltag:
www.nzz-campus.ch

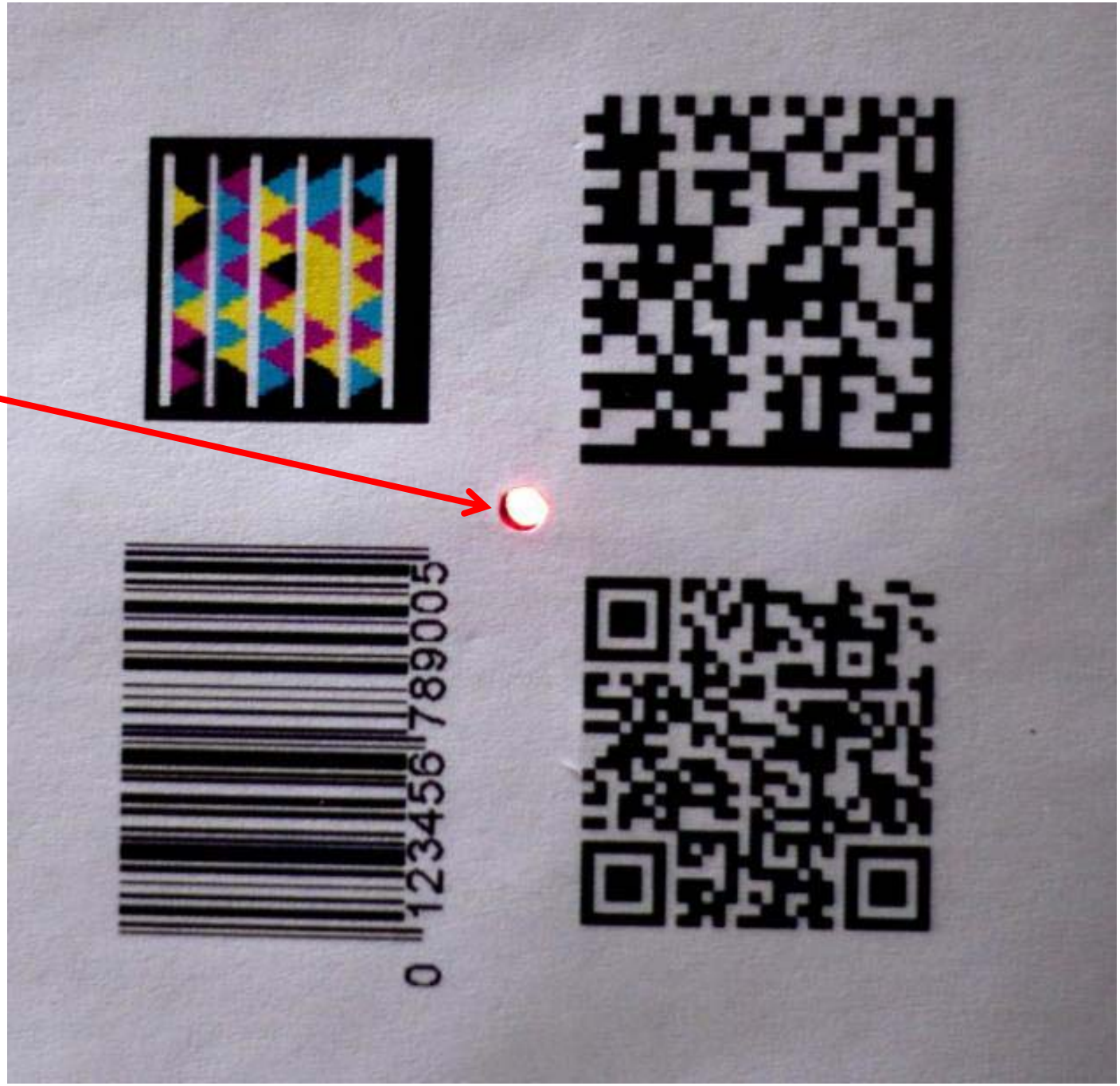

transcosmos group


www.28weekslaterdvd.co.uk
CLEARCHANNEL

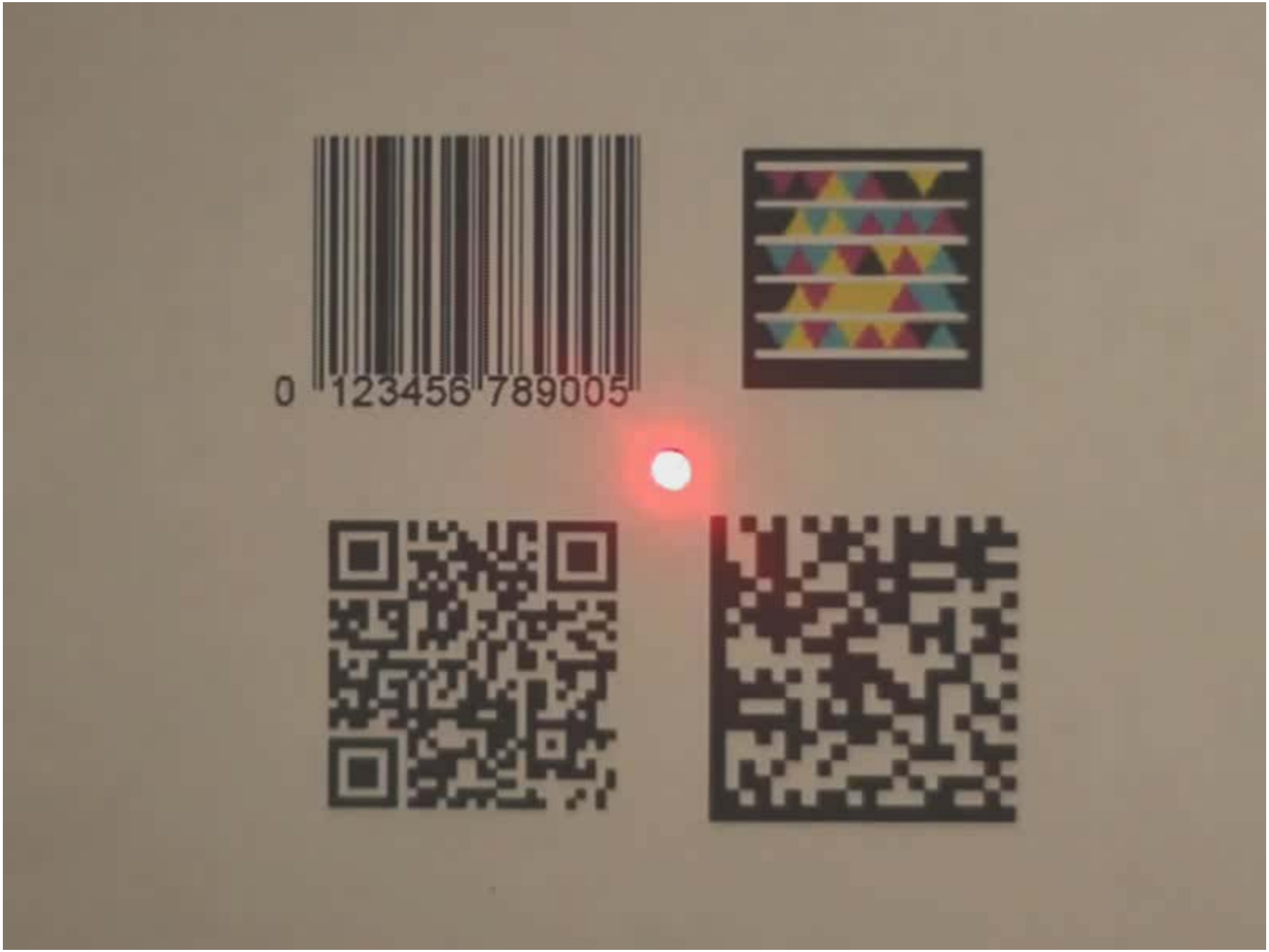

0 123456 789005



Bokode

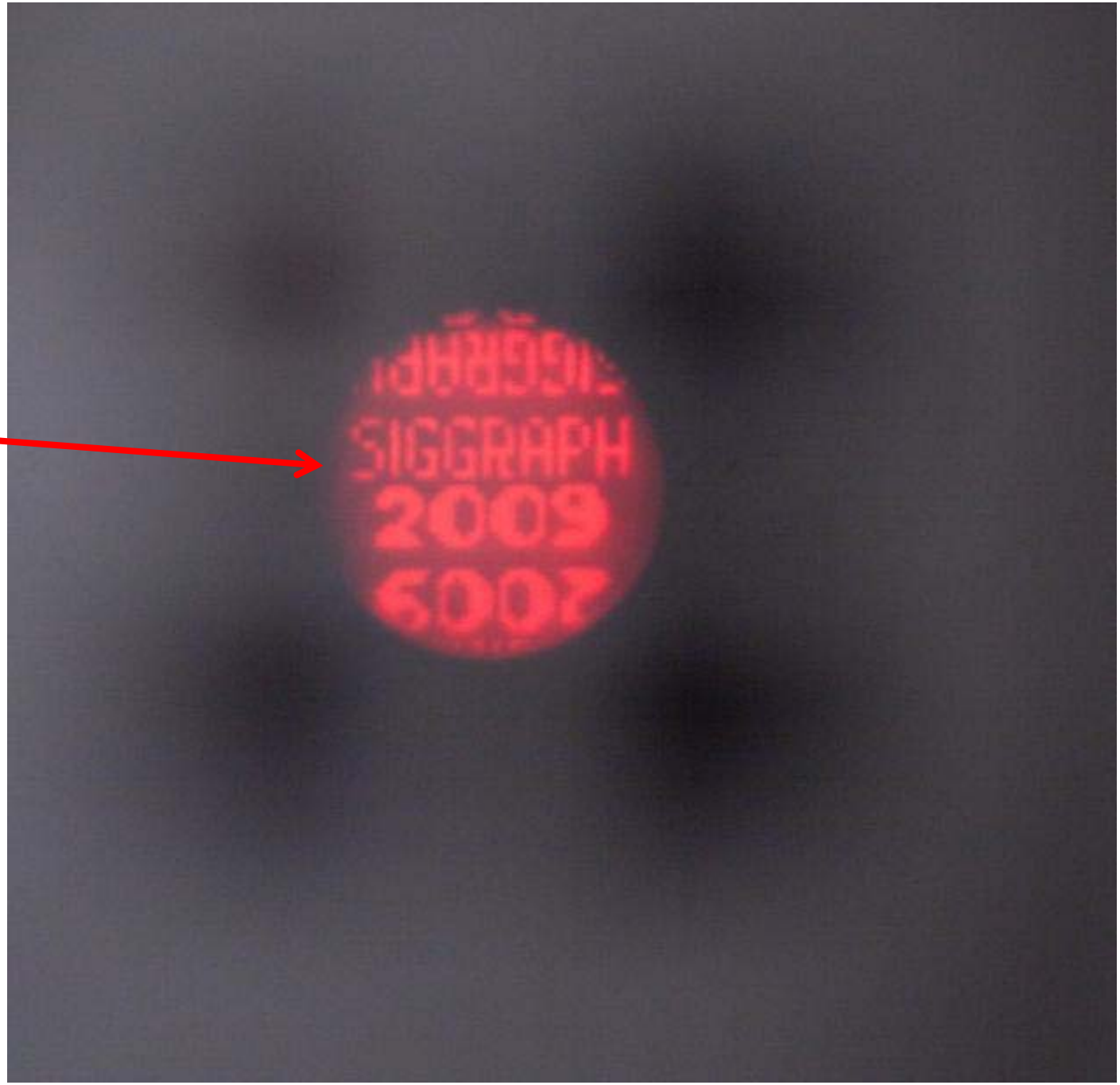


Mohan, A., G. Woo, S. Hiura, Q. Smithwick, and R. Raskar. "Bokode: Imperceptible Visual Tags for Camera-based Interaction from a Distance." *Proceedings of ACM SIGGRAPH 2009*.



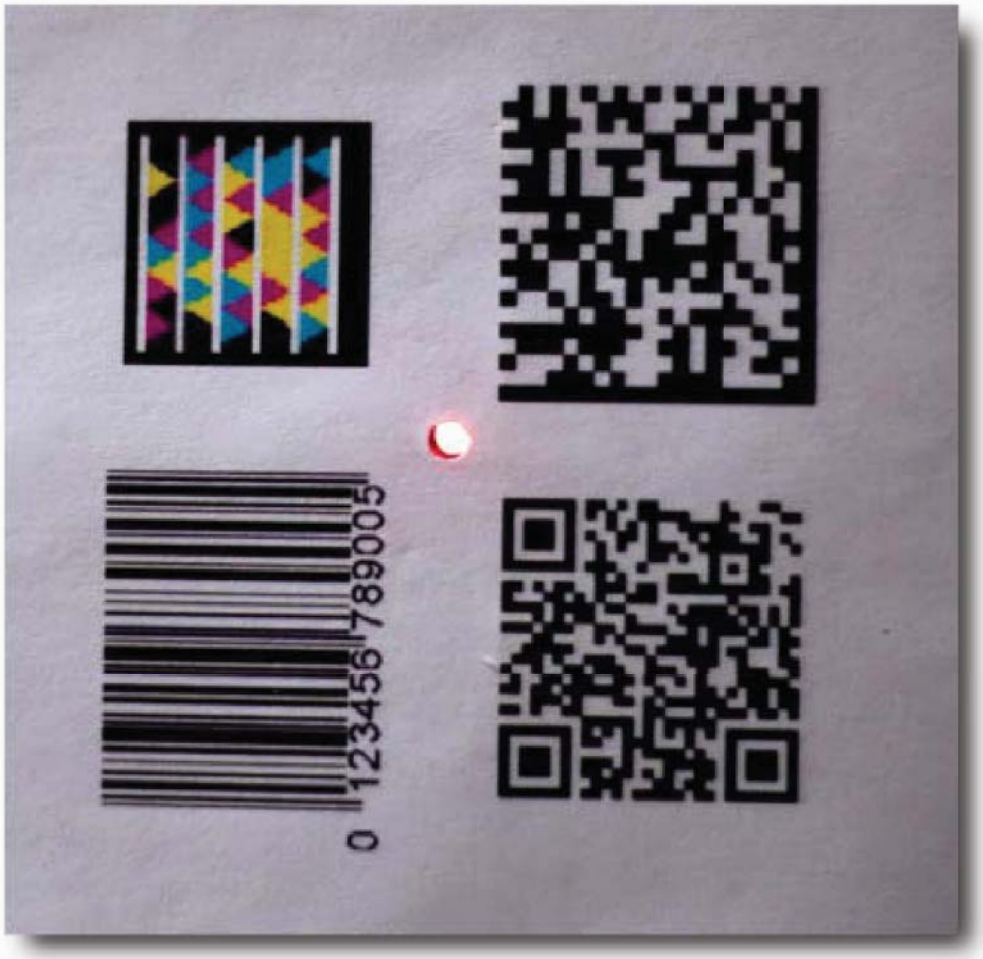
Mohan, A., G. Woo, S. Hiura, Q. Smithwick, and R. Raskar. "Bokode: Imperceptible Visual Tags for Camera-based Interaction from a Distance." *Proceedings of ACM SIGGRAPH 2009*.

Defocus blur of Bokode



Mohan, A., G. Woo, S. Hiura, Q. Smithwick, and R. Raskar. "Bokode: Imperceptible Visual Tags for Camera-based Interaction from a Distance." *Proceedings of ACM SIGGRAPH 2009*.

Coding in Angle

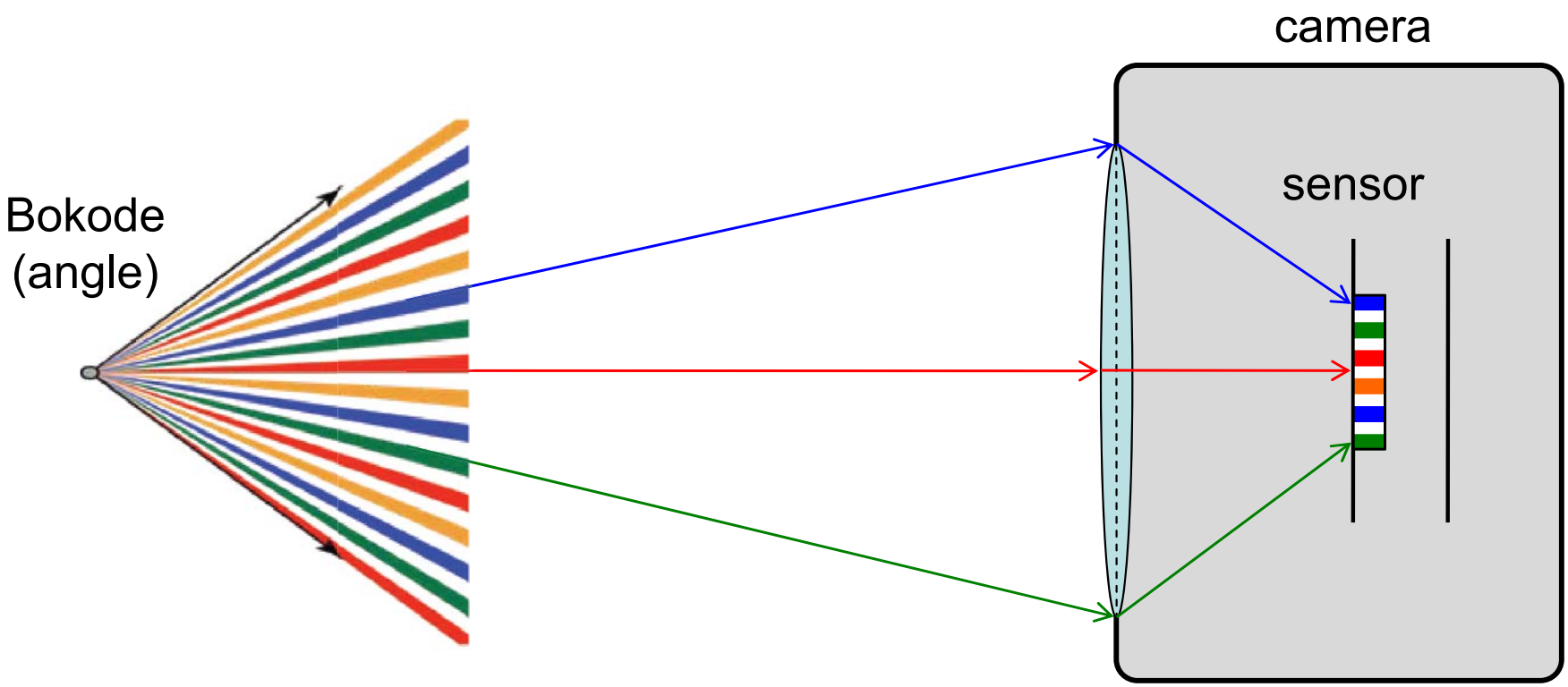


In Focus Photograph

Out of Focus Photograph

Mohan, Woo, Smithwick, Hiura, Raskar [Siggraph 2009]

Encoding in Angle, not space, time or wavelength

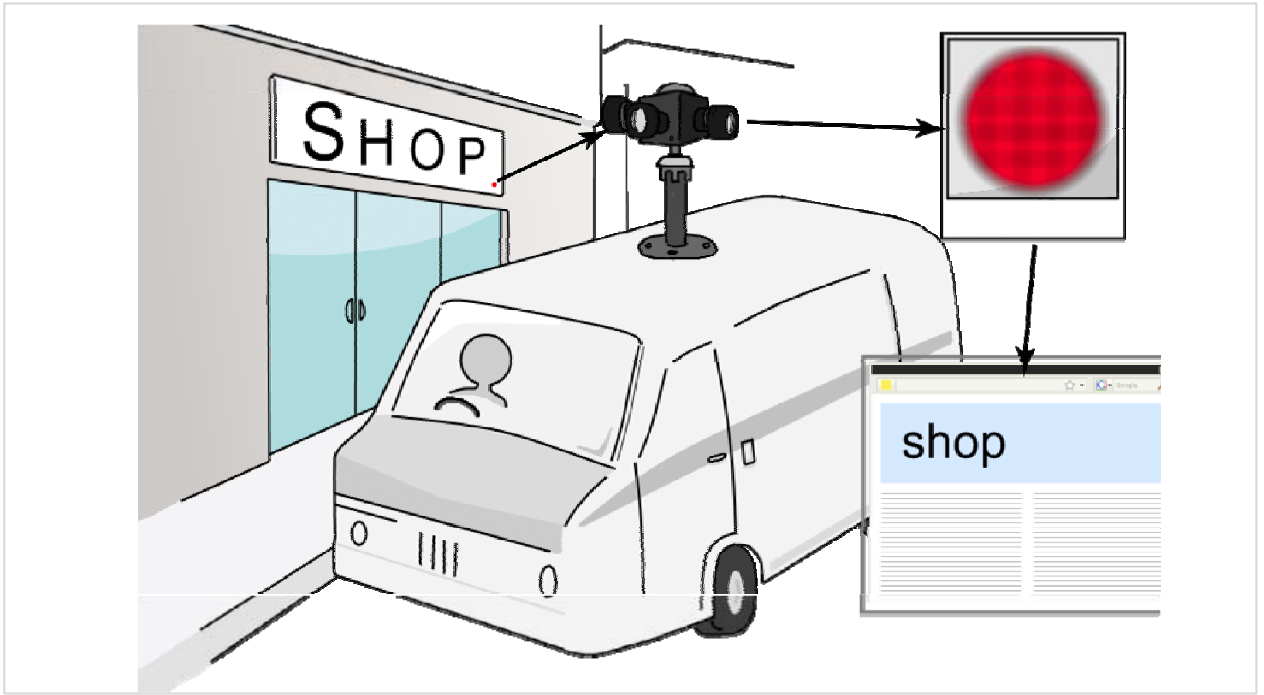


circle of confusion → circle of information

Quote suggested by Kurt Akeley

Product labels

Street-view Tagging

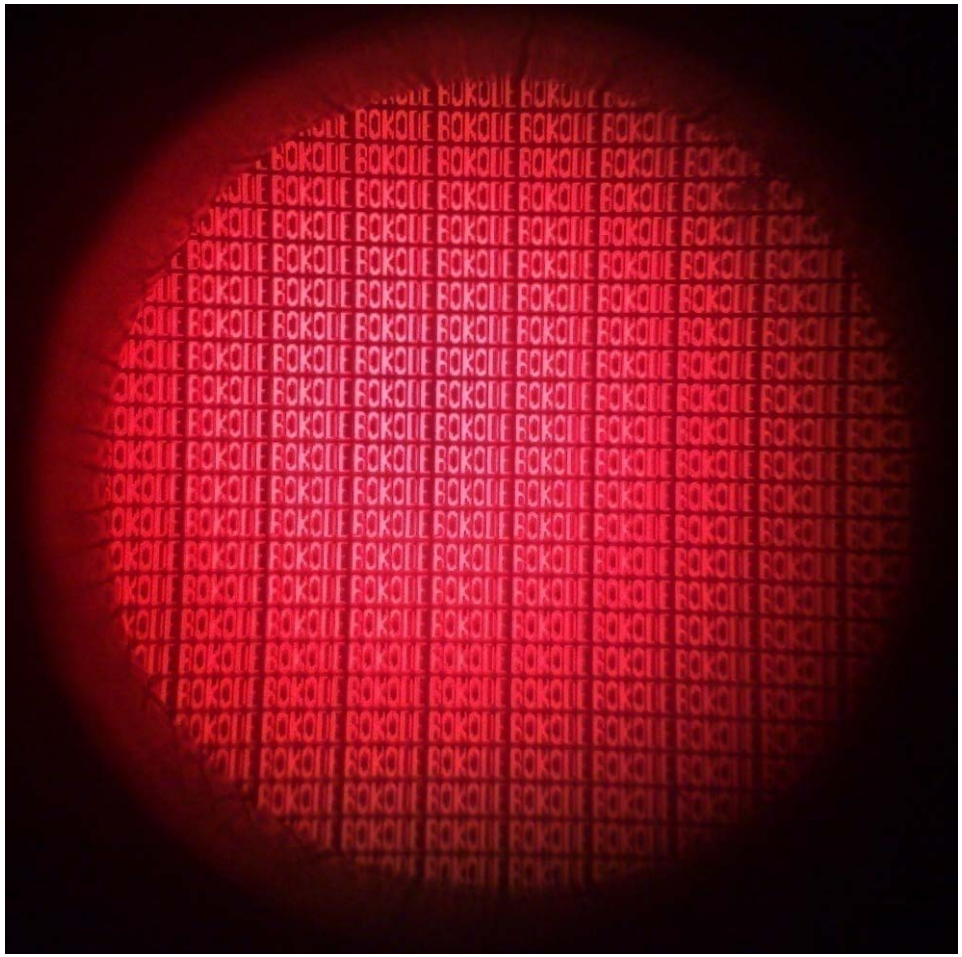


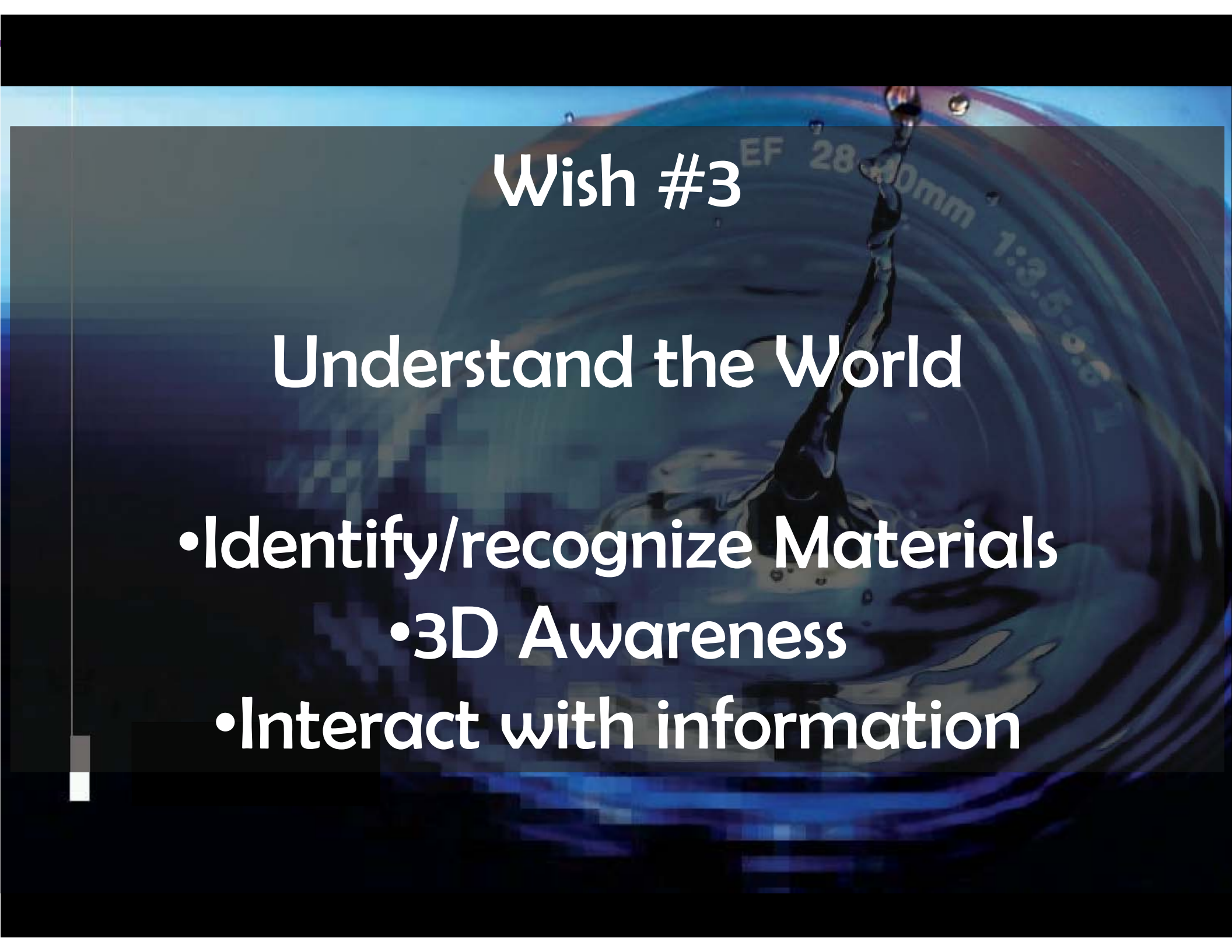
Mohan, A., G. Woo, S. Hiura, Q. Smithwick, and R. Raskar. "Bokode: Imperceptible Visual Tags for Camera-based Interaction from a Distance." *Proceedings of ACM SIGGRAPH 2009*.

capturing Bokodes

cell-phone camera close to the Bokode

(10,000+ bytes of data)





Wish #3

Understand the World

- Identify/recognize Materials
- 3D Awareness
- Interact with information

Wish #4

Sharing Visual Experience

Wish #4

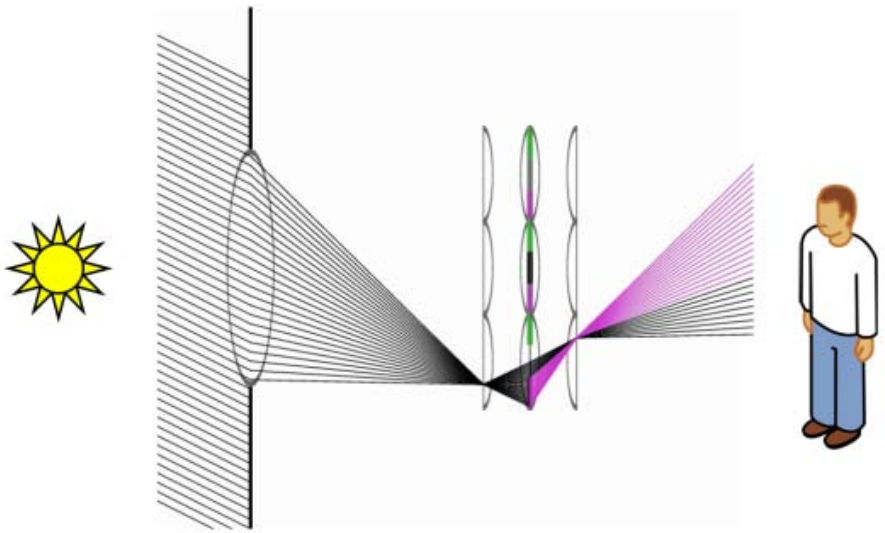
Sharing Visual Experience

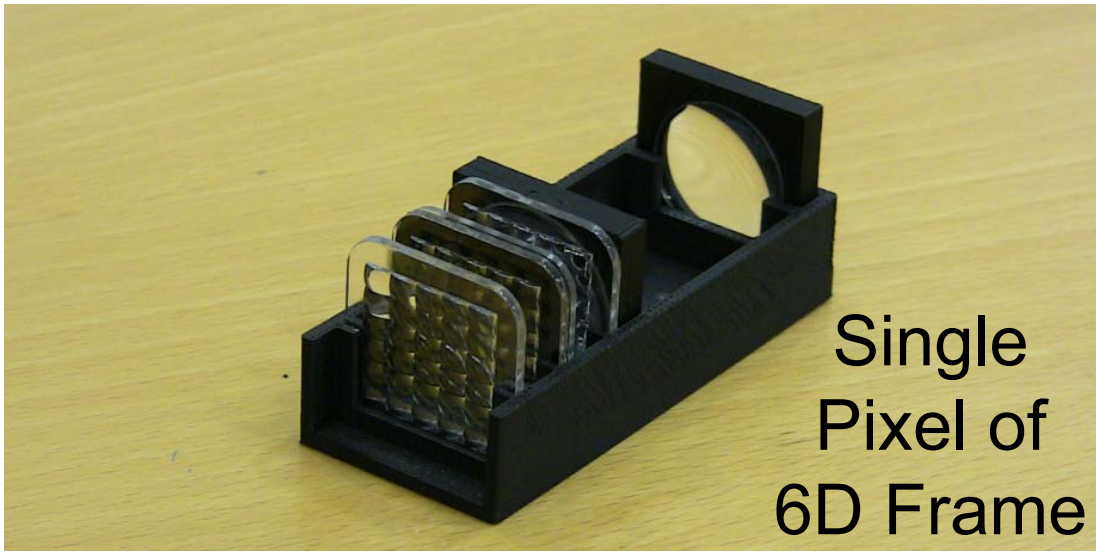
- LifeLog Auto-summary
- Privacy in public and authentication
- Great Photo-frames

6D Photo Frames

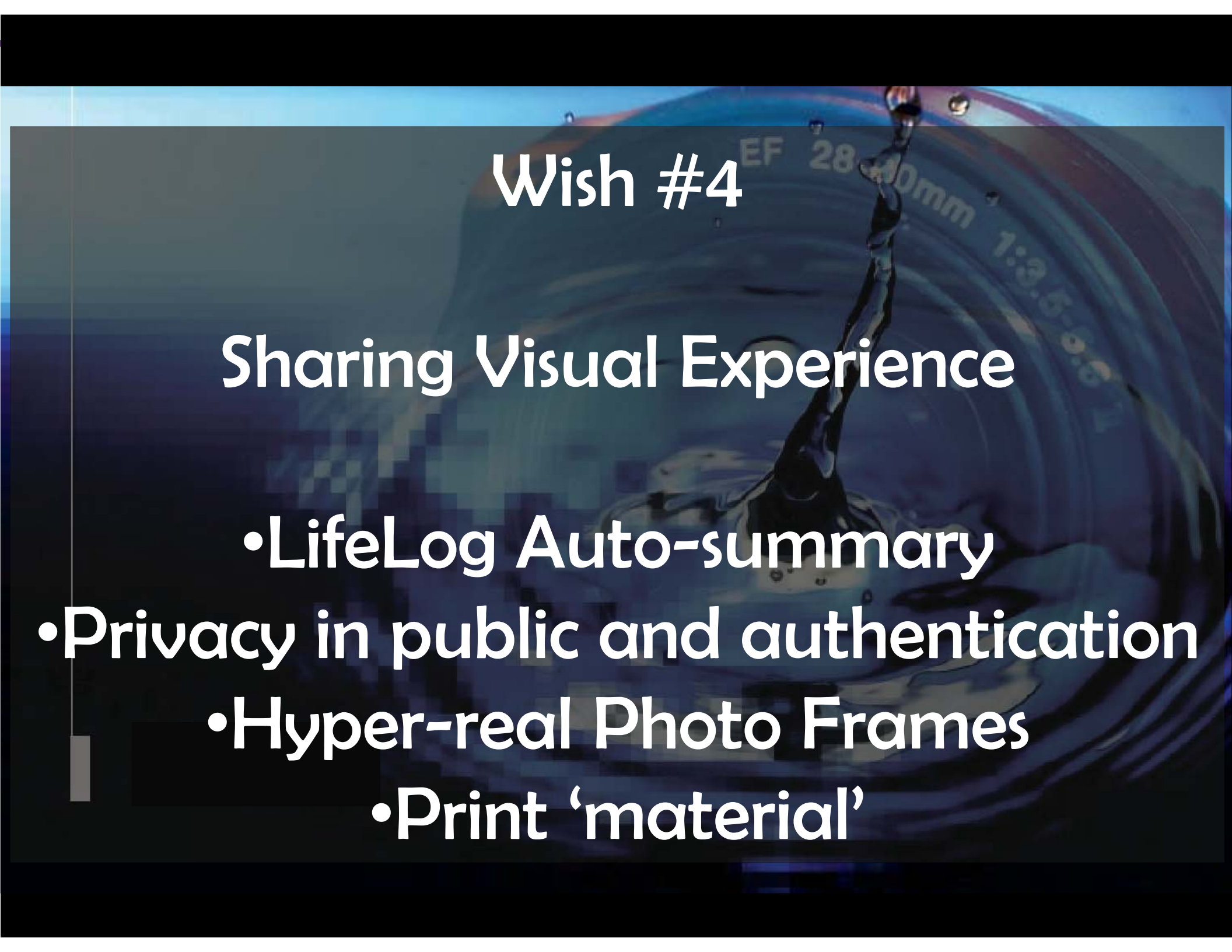
1 1

One Pixel of a 6D Display = 4D Display





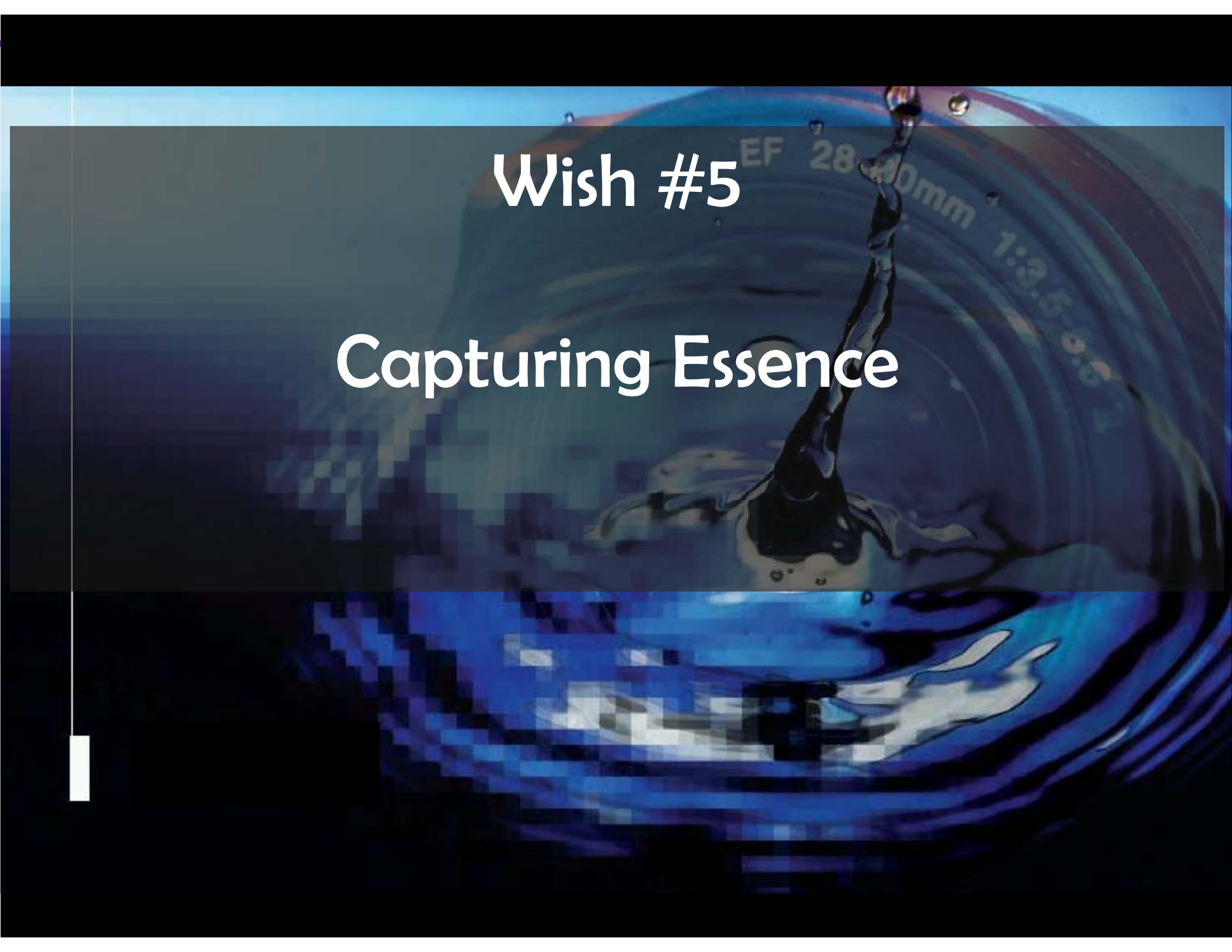
Fuchs, Raskar, Seidel, and Lensch. Towards passive 6D reflectance field displays. *Proceedings of SIGGRAPH 2008.*
See also http://web.mit.edu/newsoffice/2008/camera-0807.html.



Wish #4

Sharing Visual Experience

- LifeLog Auto-summary
- Privacy in public and authentication
- Hyper-real Photo Frames
- Print 'material'



Wish #5

Capturing Essence

Essence Photography

Image removed due to copyright restrictions.
See Fig. 1 in Jingyi Yu and Leonard McMillan, “A Framework for Multiperspective Rendering”, Rendering Techniques 04, Eurographics Symposium on Rendering (EGSR), 2004, Norrkoping, Sweden.
http://graphics.cis.udel.edu/research/EGRW04/EGSR2004.pdf

- Beyond physical realism
- New Visual Art Forms

Image removed due to copyright restrictions.
Car maintenance manual figure showing where to fill the radiator.

What are the problems with ‘real’ photo in conveying information ?

Why do we hire artists to draw what can be photographed ?

Image removed due to copyright restrictions.
Car maintenance manual figure showing where to fill the radiator.

Shadows

Clutter

Many Colors

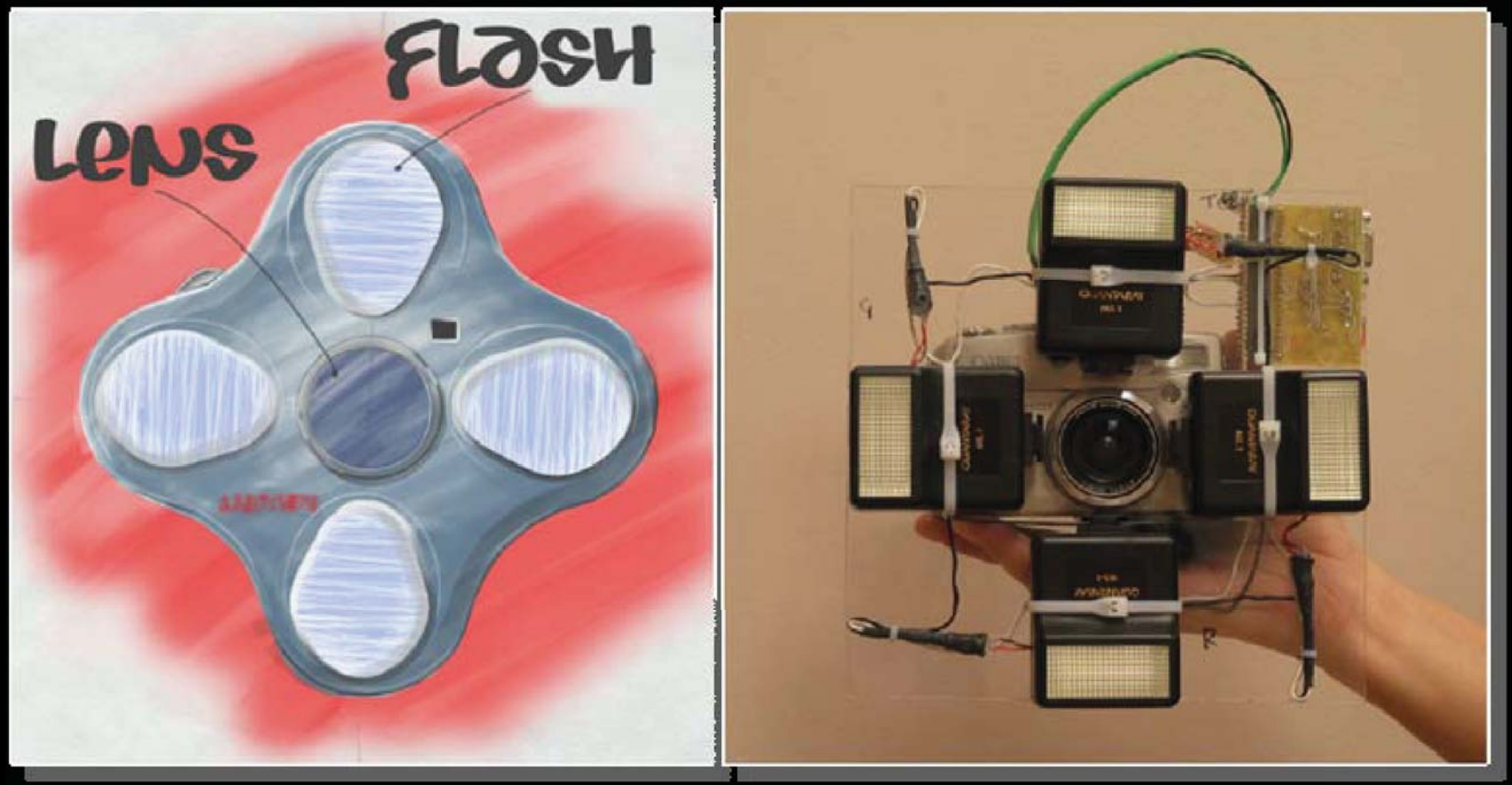
Highlight Shape Edges

Mark moving parts

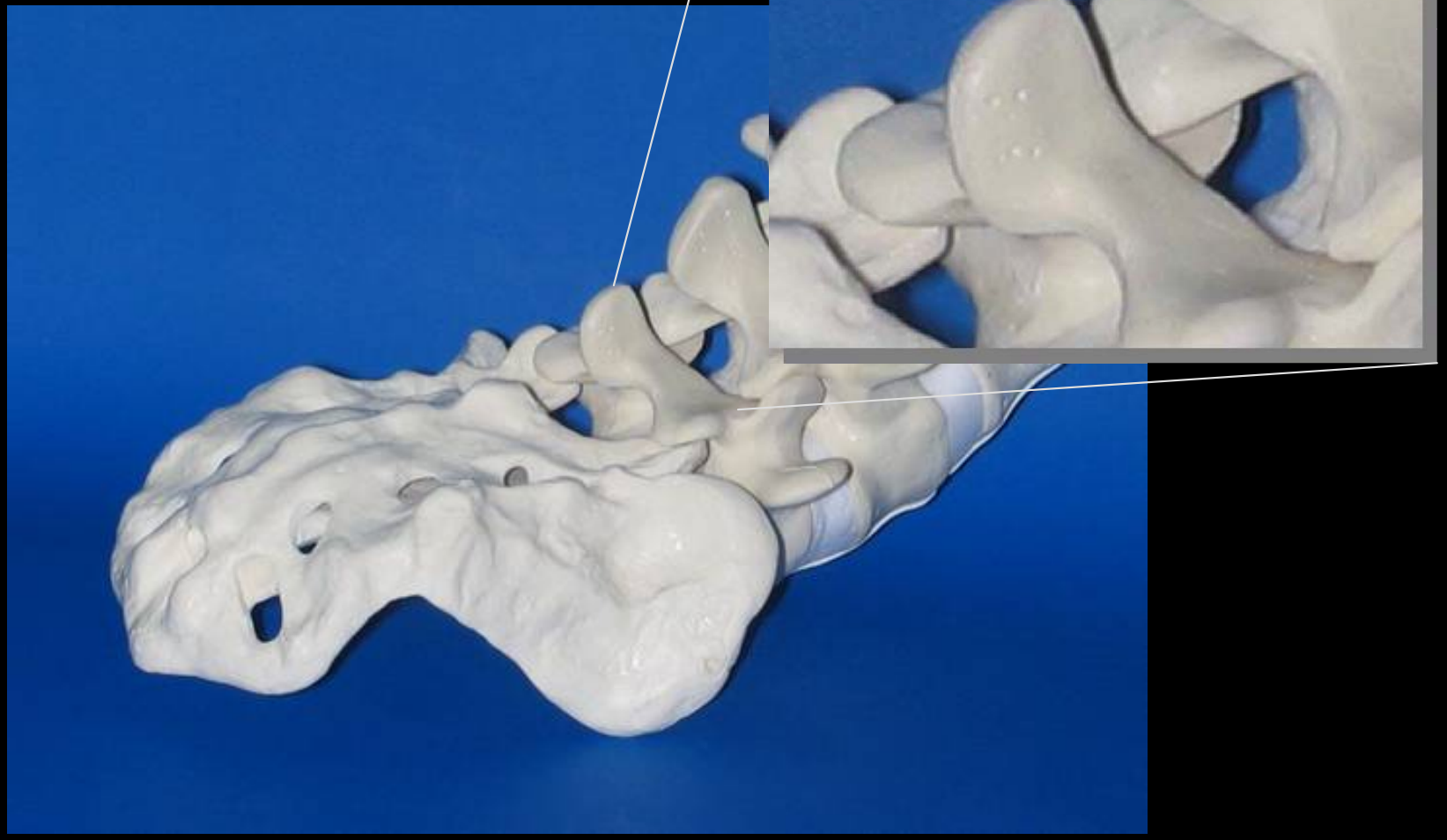
Basic colors

Depth Edges with MultiFlash

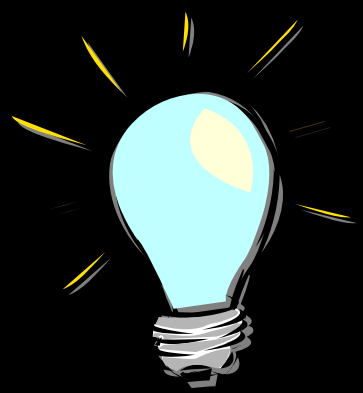
Raskar, Tan, Feris, Jingyi Yu, Turk – ACM SIGGRAPH 2004



Courtesy of MERL. Used with permission.



Courtesy of MERL. Used with permission.



Courtesy of MERL. Used with permission.

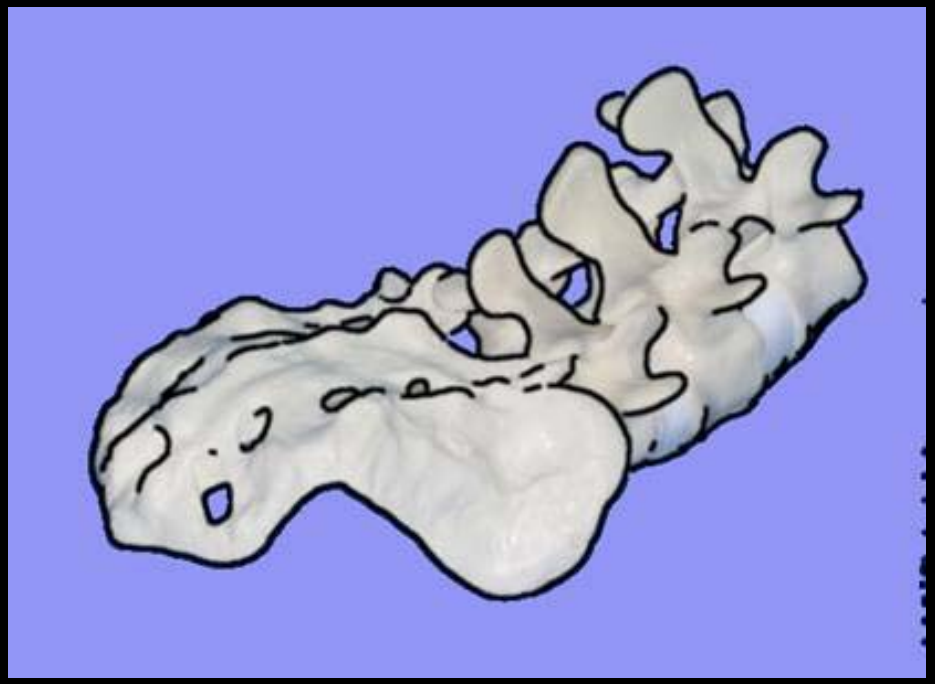
Courtesy of MERL. Used with permission.

Courtesy of MERL. Used with permission.

Depth Discontinuities

Internal and external

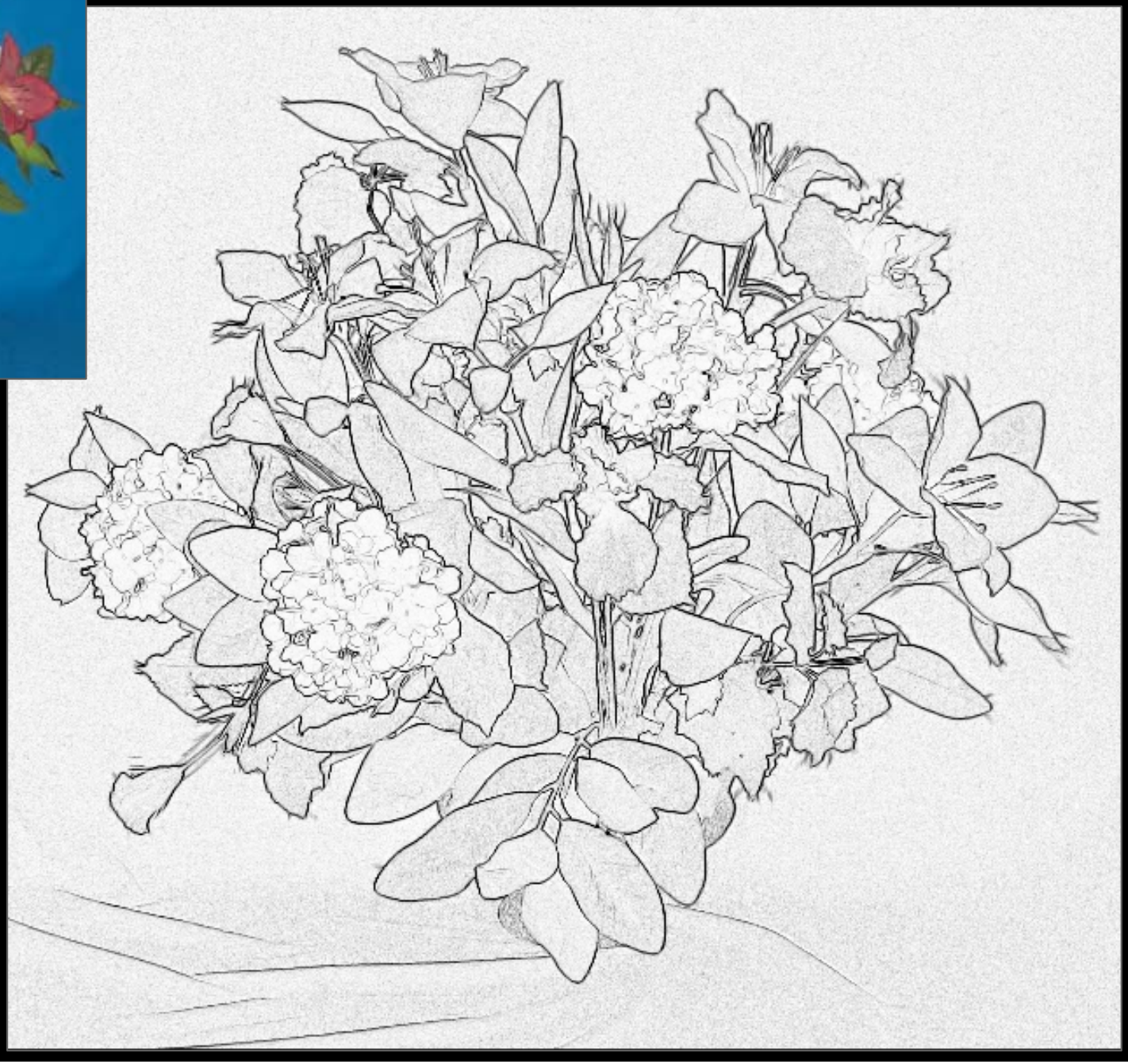
Shape boundaries, Occluding contour, Silhouettes



Canny

Our Method

Courtesy of MERL. Used with permission.



Courtesy of MERL. Used with permission.

Blind Camera

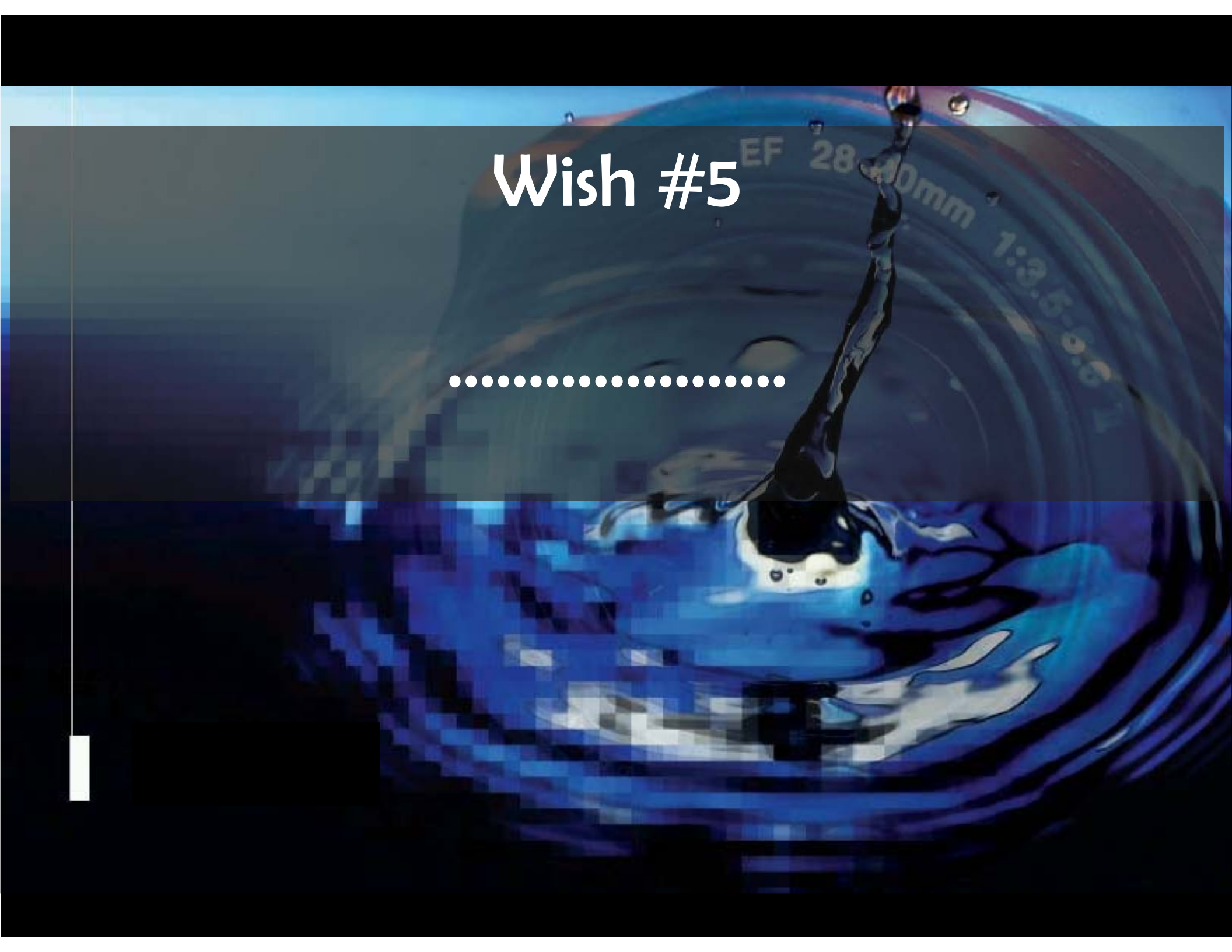
Images removed due to copyright restrictions.
See "Buttons: A Blind Camera"
http://www.blinksandbuttons.net/buttons_en.html

Sascha Pohflepp,
U of the Art, Berlin, 2006

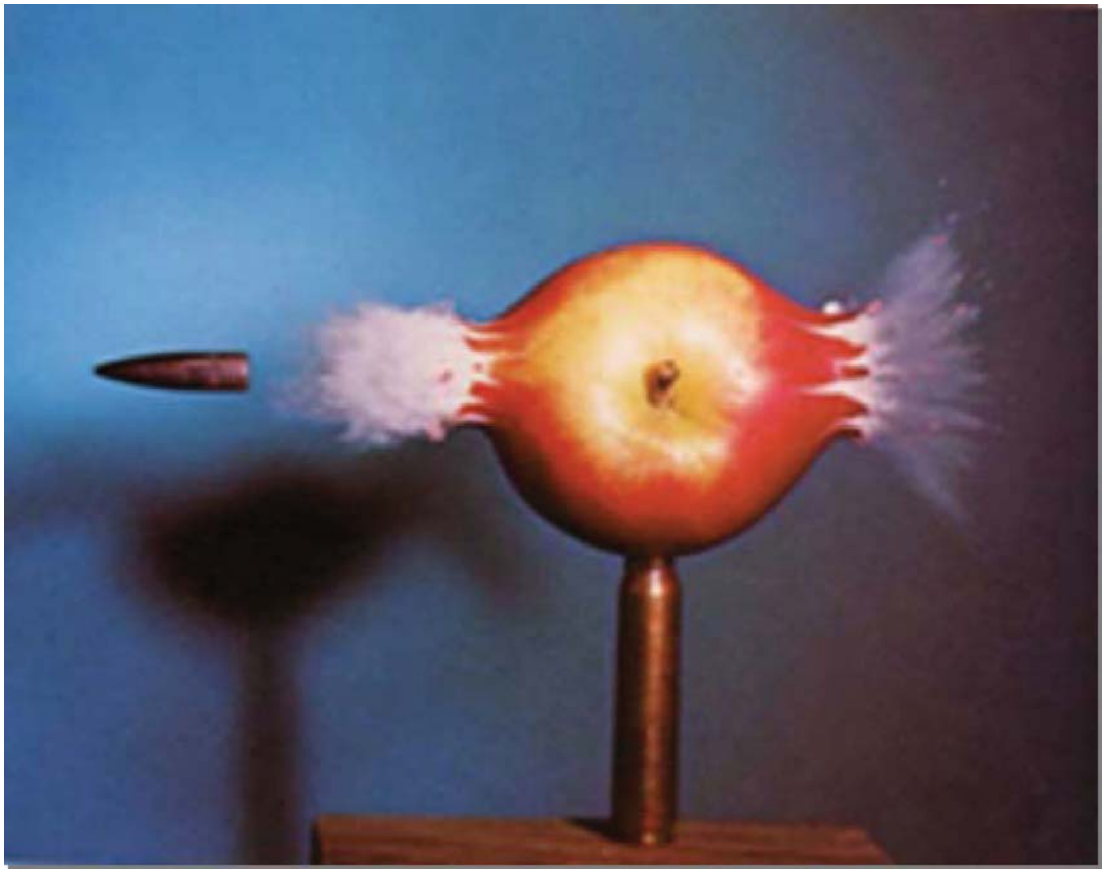
Scene Completion Using Millions of Photographs

Hays and Efros, Siggraph 2007

Images removed due to copyright restrictions.
See "Buttons: A Blind Camera"
http://www.blinksandbuttons.net/buttons_en.html


Wish #5

Photos of tomorrow: computed not recorded



Edgerton, Harold E. MIT Museum, Cambridge MA.
MIT Museum, Edgerton Digital Collections.
http://edgerton-digital-collections.org

Image removed due to copyright restrictions.
Airplane propeller aliasing; see
http://scalarmotion.wordpress.com/2009/03/15/propeller-image-aliasing/

Questions

- What will a camera look like in 10,20 years?
- How will a billion networked and portable cameras change the social culture?
- How will online photo collections transform visual social computing?
- How will movie making/new reporting change?
- computational-journalism.com

2nd International Conference on Computational Photography

Papers due November 2, 2009

iccp 10

International Conference on Computational Photography

March 26-27, 2010

MIT, Cambridge, MA

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The field of Computational Photography seeks to create new photographic functionalities and experiences that go beyond what is possible with traditional cameras and image processing tools. Submissions on the following topics are encouraged:

Computational Cameras: The use of optical coding followed by computational decoding to produce new or enhanced images and videos. Examples include catadioptric, coded aperture, integral/plenoptic, coded exposure, lensless, assorted pixel, compressive, holographic and depth imaging. Novel computational image detectors that facilitate the creation of new images are also included.

Multiple Images and Camera Arrays: The use of multiple images captured sequentially or simultaneously followed by processing to produce new or enhanced images. Examples include mosaicing, creation of collages and montages, refocusing, and light field rendering. Also included are the use of multiple images to achieve high dynamic range, extended depth of field, super-resolution, denoising, multispectral imaging and polarization imaging.

Computational Illumination: The use of programmable light sources to capture images followed by processing to produce new or enhanced images. Examples include structured light for depth/normal estimation, image based relighting, flash/no-flash methods for image enhancements, separation of reflection components, detection of material properties and light transport measurement and manipulation.

Advanced Image and Video Processing: The use of innovative computational methods to break the fundamental limits of traditional image processing and produce new or enhanced images. Examples include the use of image priors for enhancement, image matting, image filling, and view interpolation.

Scientific Photography and Videography: The use of imaging systems to gather quantitative information about physical systems and processes as diverse as individual cells and galaxies. Examples include application in microscopy, biomedical imaging, remote sensing and astronomy.

Important Dates

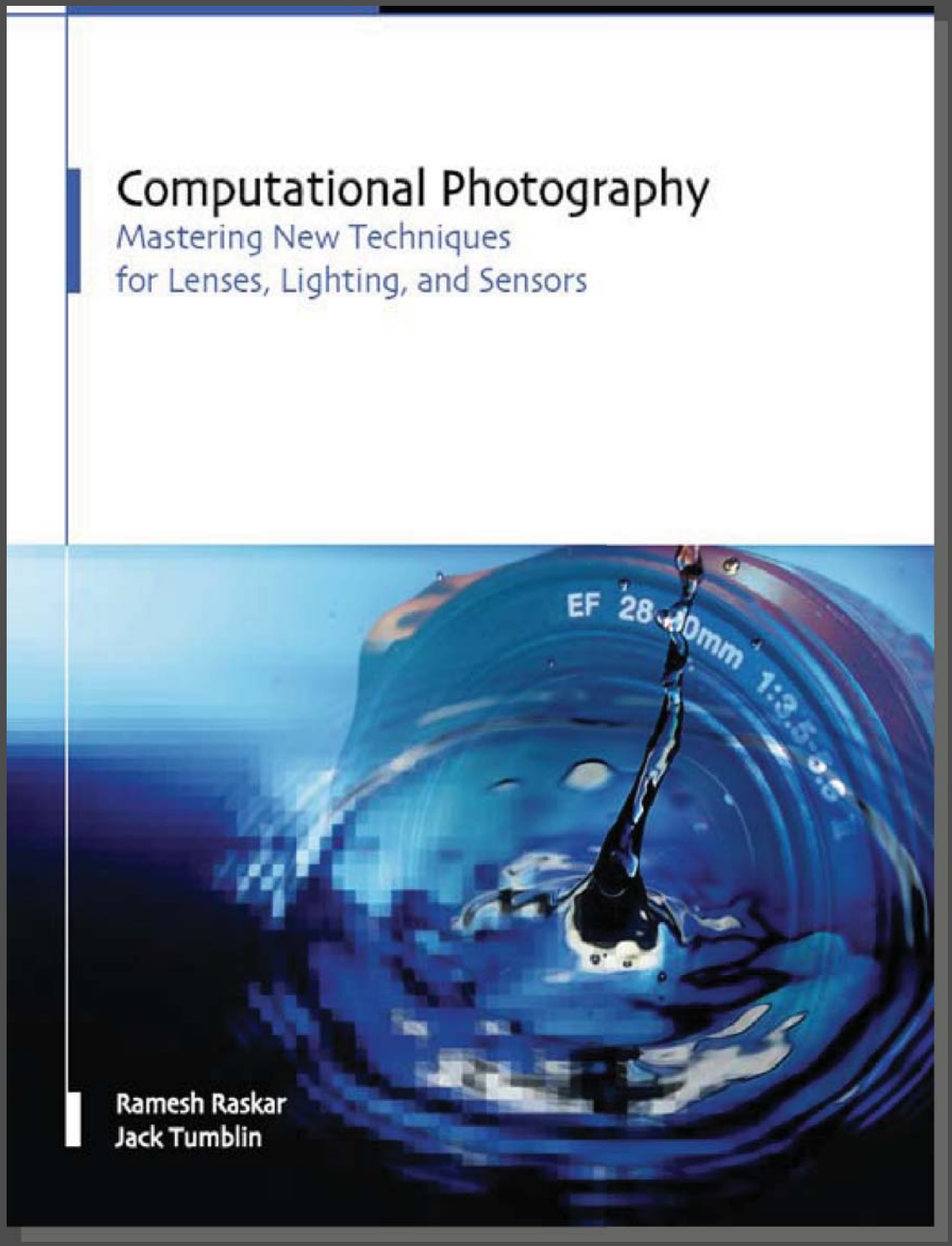
Submission of full paper	November 2, 2009
Notification of acceptance	February 2, 2010
Conference	March 26-27, 2010

detailed submission

/iccp10

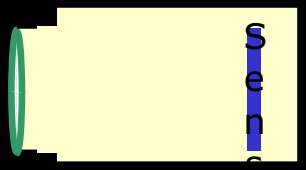
http://cameraculture.media.mit.edu/iccp10

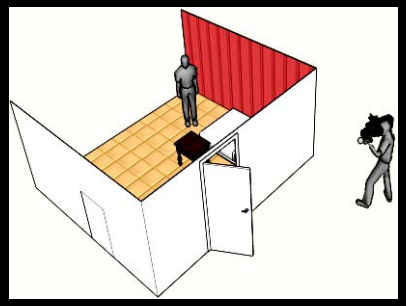
- Ramesh Raskar and Jack Tumblin
- Book Publishers: A K Peters
- ComputationalPhotography.org

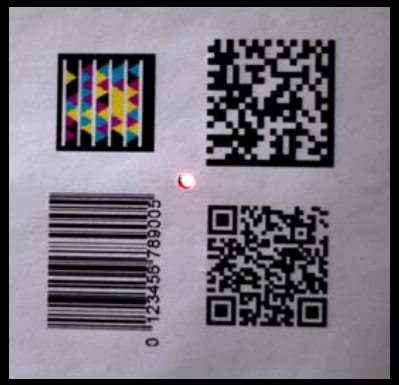


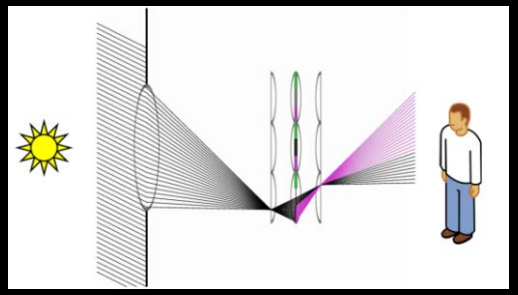
Computational Photography Wish List

- Post-capture control
  - Emulate studio lights with compact flash
  - Focus and motion blur
- New forms
  - Flat camera, large LCDs as cameras
  - Image destabilization for larger aperture
- Understand the world
  - Real or fake
  - Place 2D photo into 3D
  - Look around corner
  - Bokode: long distance barcode
- Sharing
  - Lifelogs auto summary
  - Privacy/Verification
  - 6D photoframes
- Essence
  - New visual arts
  - Multi-flash camera
  - Delta-camera and Blind-camera









MAS.531 / MAS.131 Computational Camera and Photography

Fall 2009