University of Essex

University of St Andrews
Scotland's first university

600 YEARS
1413 – 2013

Developing a data-set for stereopsis

David W. Hunter, Paul B. Hibbard

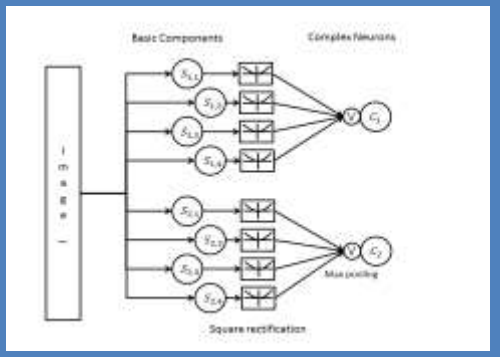
BBSRC
20 Years of Pioneering
Great British Bioscience

Seeing in Depth[1]

Stereoscopic view

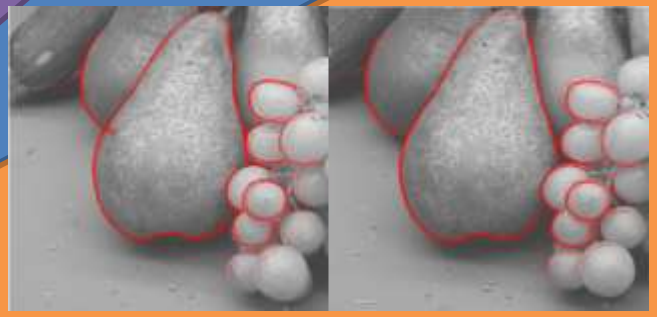
Depth

Statistical Models of Disparity[2,3]



Modelling

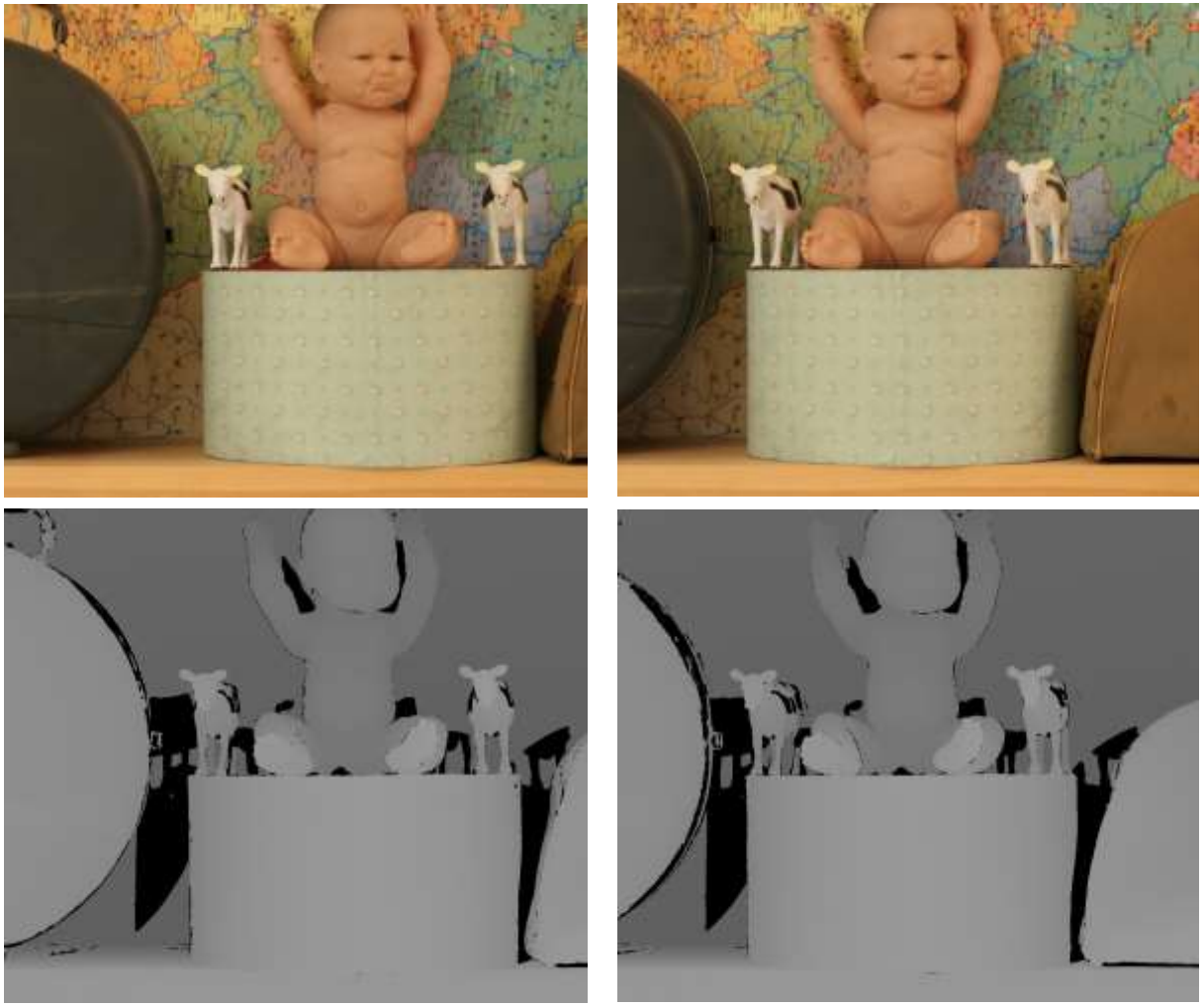
Psychophysics



Modelling Perception of Boundaries[4]

1. Learning to see in depth: neural models of binocular stereopsis BBSRC grant code BB/K018973/1
2. Hibbard, Paul B. "Binocular energy responses to natural images." *Vision research* 48.12 (2008): 1427-1439.
3. D W Hunter, P B Hibbard, **"Statistics of Natural Binocular Images"** *i-Perception* 4.7 (2013): 485-485
4. Goutcher, R., D. W. Hunter, and P. B. Hibbard. "Tuned Inhibitory Responses in Binocular Natural Images." *i-Perception* 4.7 (2013): 484-484.

Middlebury dataset

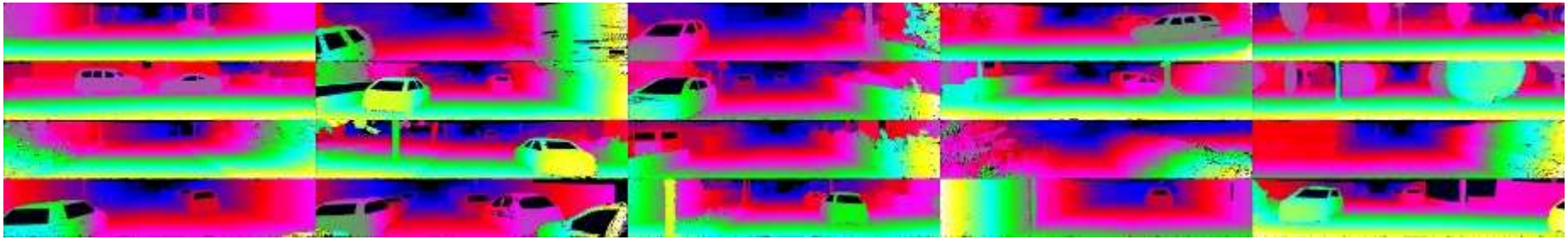


http://vision.middlebury.edu/stereo/

H. Hirschmüller and D. Scharstein. Evaluation of cost functions for stereo matching.
In *IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR 2007),* Minneapolis, MN, June 2007.

The KITTI vision benchmark suite

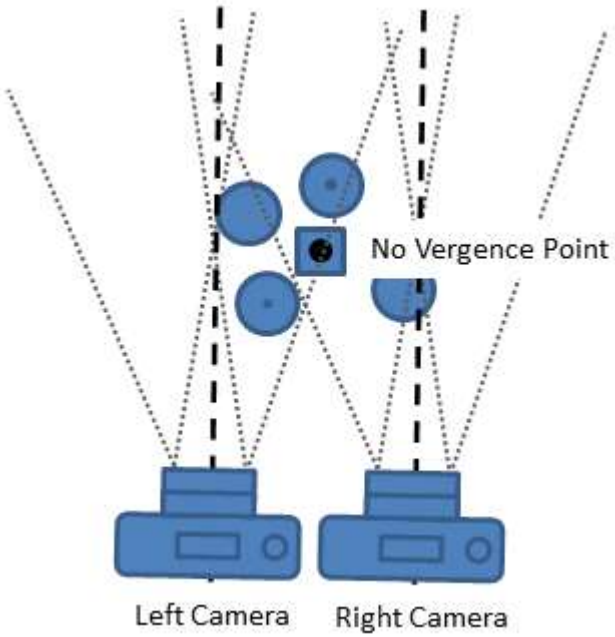
http://www.cvlibs.net/datasets/kitti/eval_stereo_flow.php?benchmark=stereo



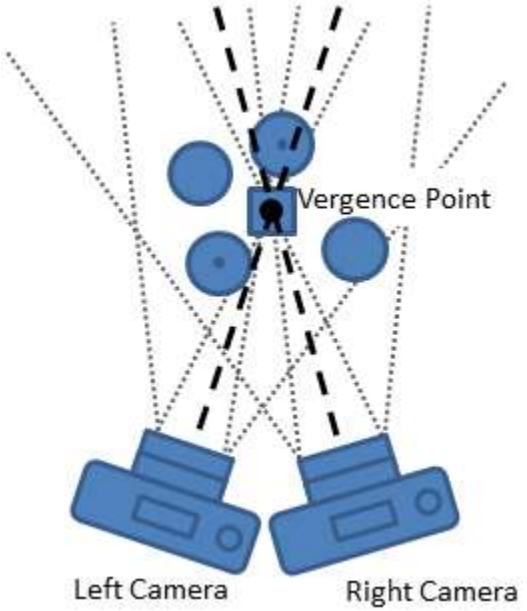
Geiger, Andreas, Philip Lenz, and Raquel Urtasun. "Are we ready for autonomous driving? The KITTI vision benchmark suite." *Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on*. IEEE, 2012.

Stereoscopic Dataset

Frontoparallel



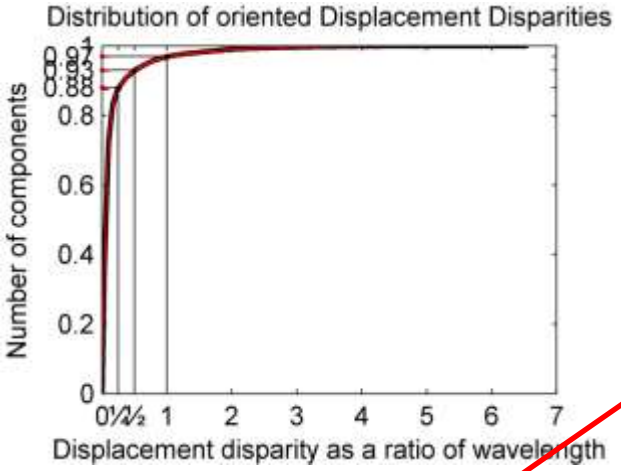
Vergent

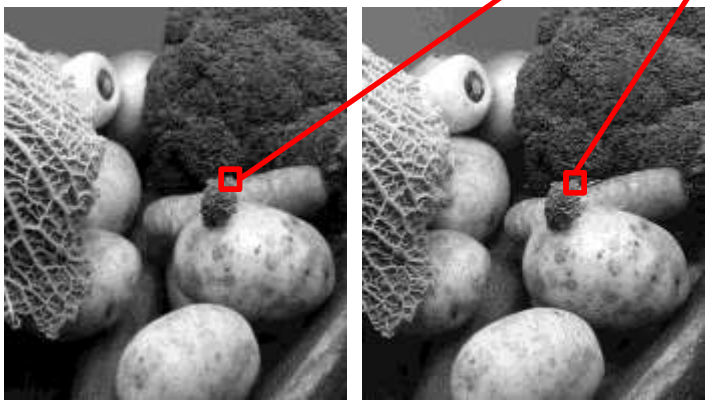


Binocular energy responses to natural images

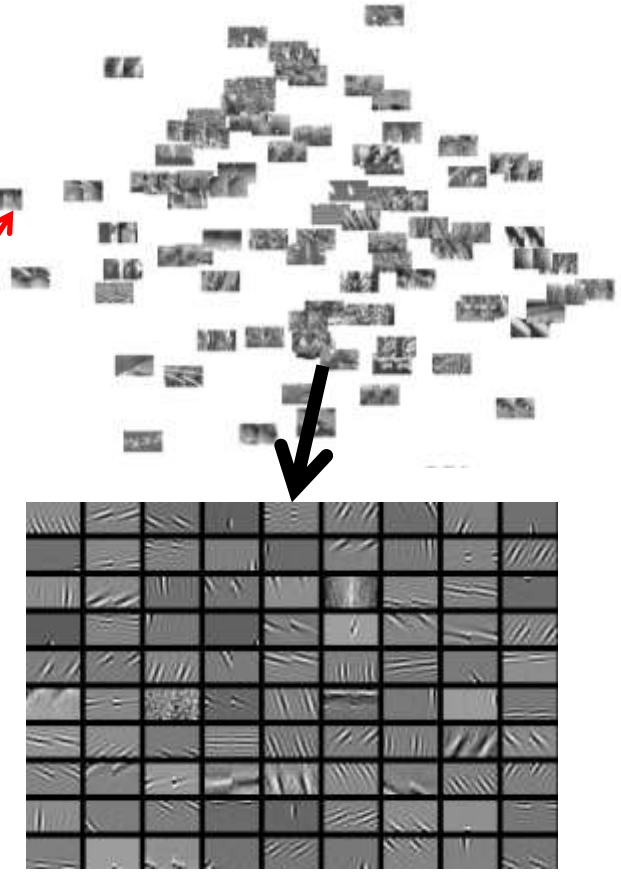
Hibbard, Paul B. "Binocular energy responses to natural images." *Vision research* 48.12 (2008): 1427-1439.

Binocular image statistics





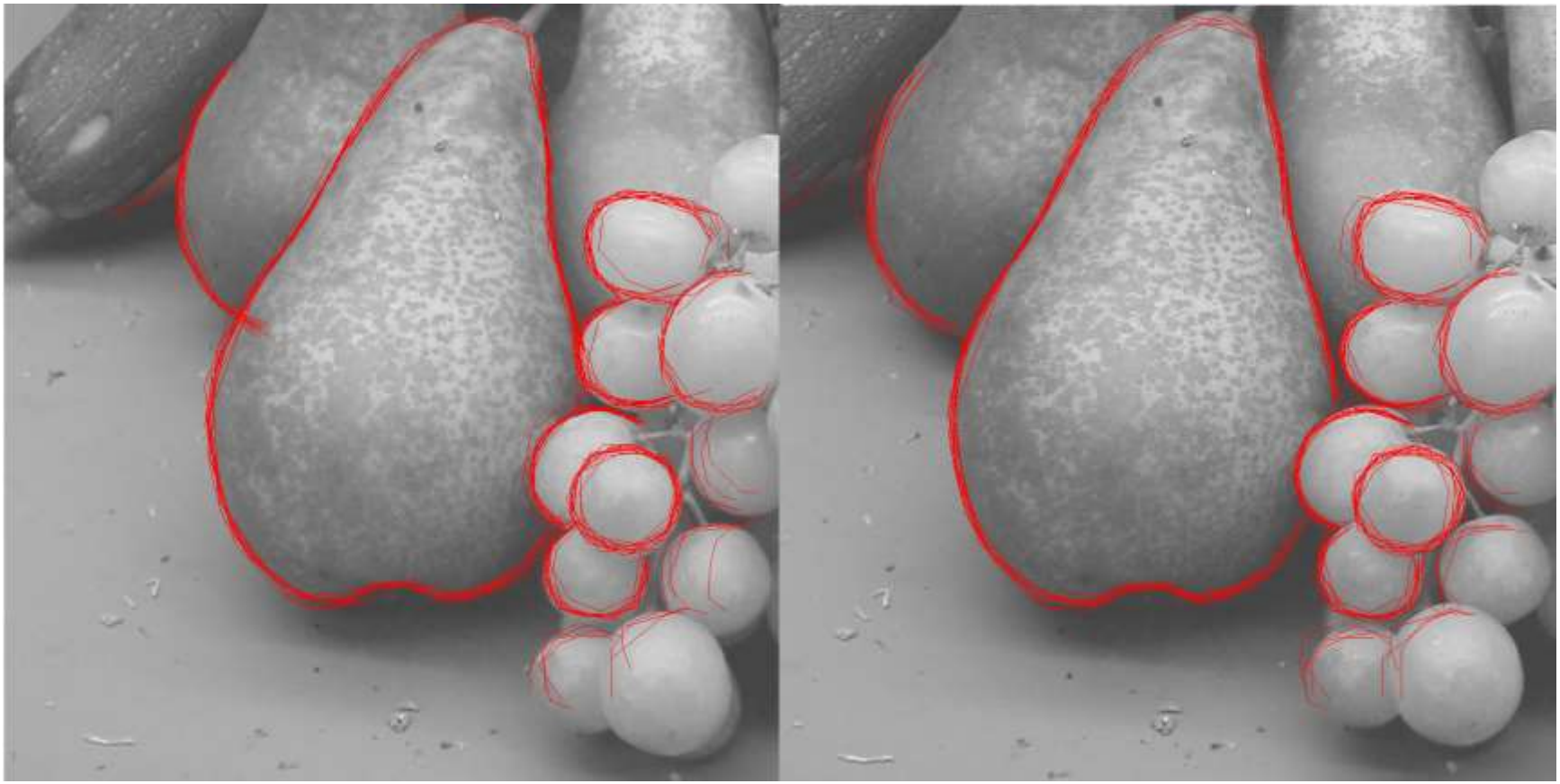
Stereoscopic image pairs



ICA components

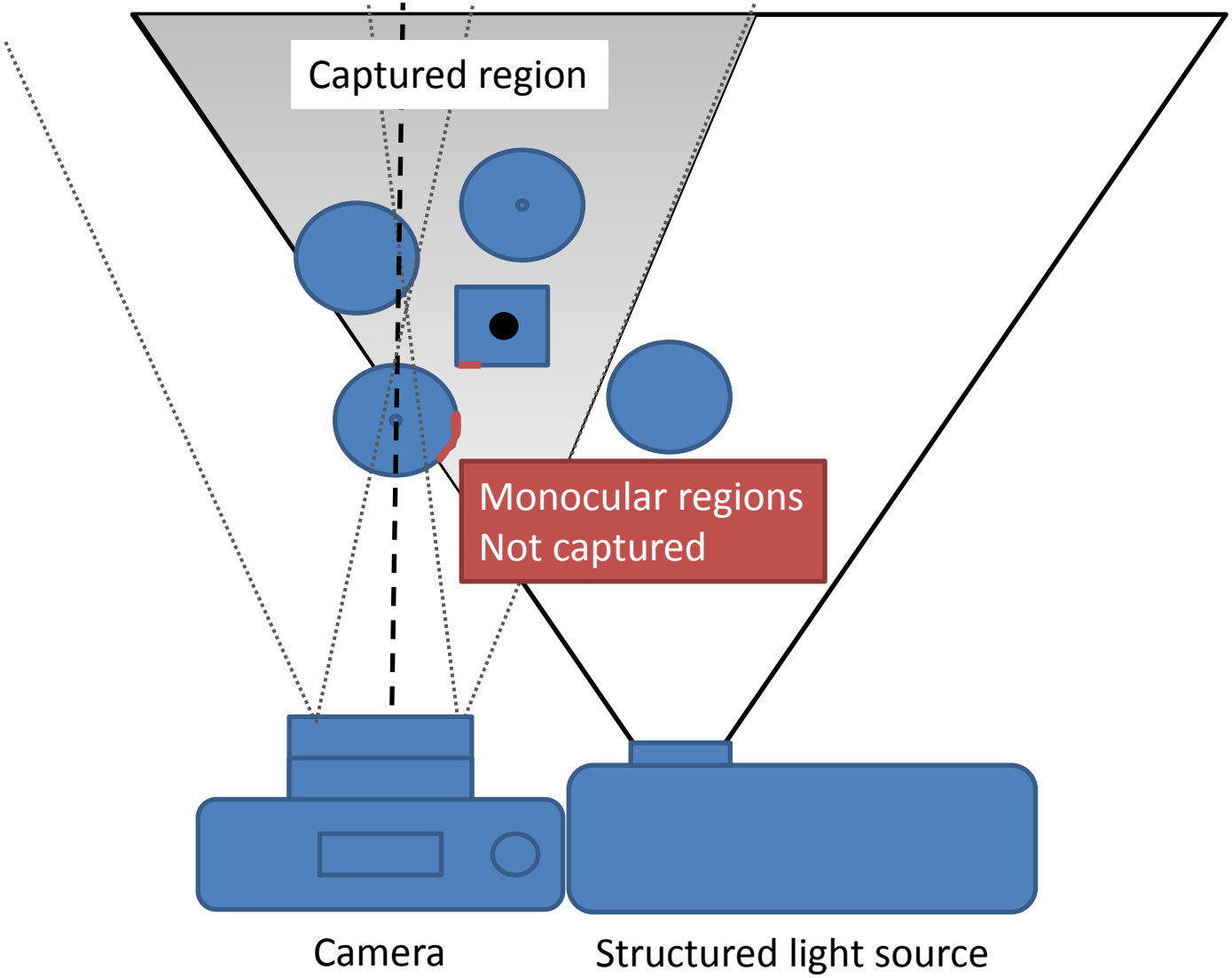
D.W. Hunter, P.B. Hibbard “Distribution of independent components of binocular natural images.” Journal of Vision (in review)

Perceived Object Boundaries

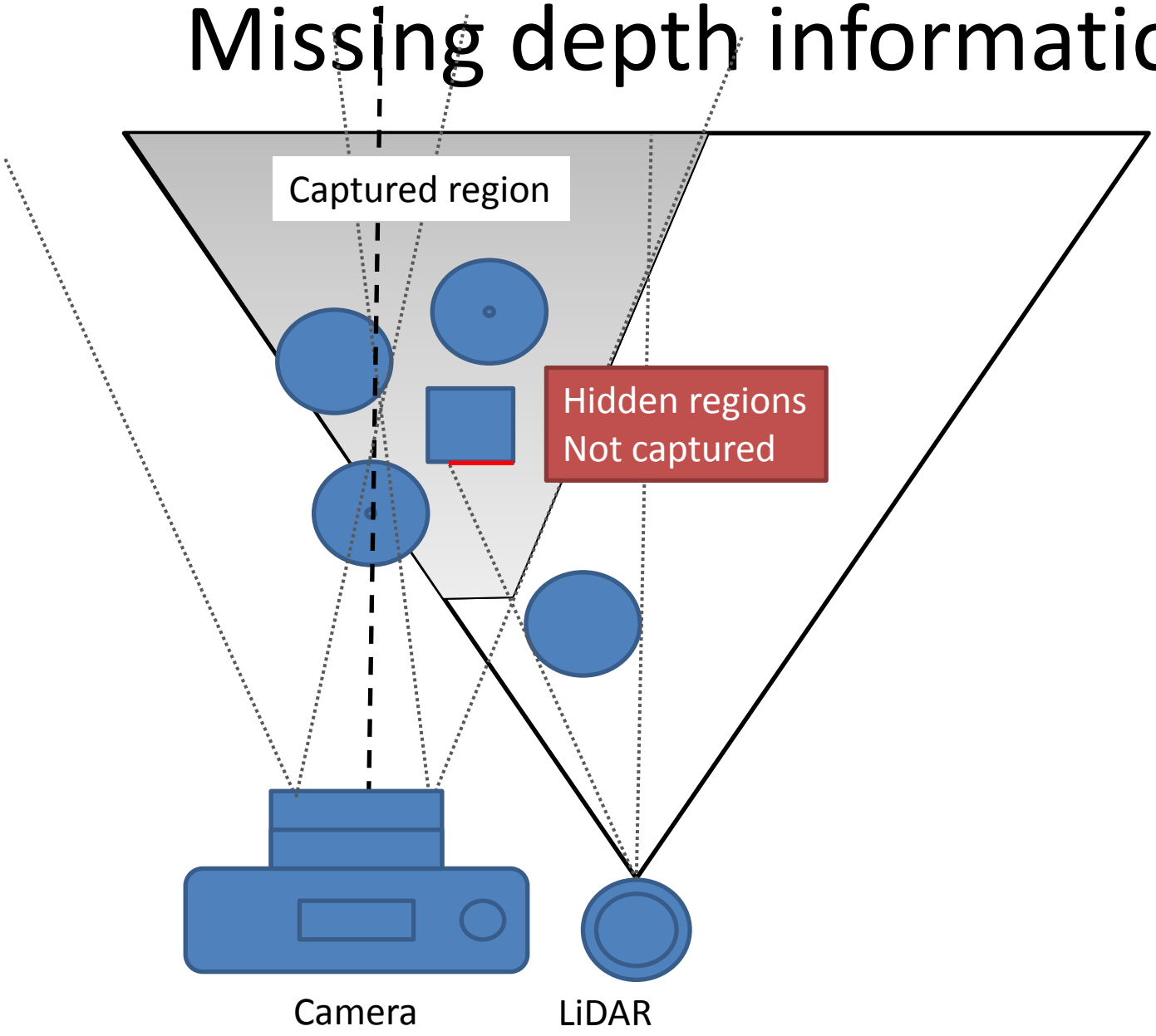


Goutcher, R., D. W. Hunter, and P. B. Hibbard. "Tuned Inhibitory Responses in Binocular Natural Images." *i-Perception* 4.7 (2013): 484-484.

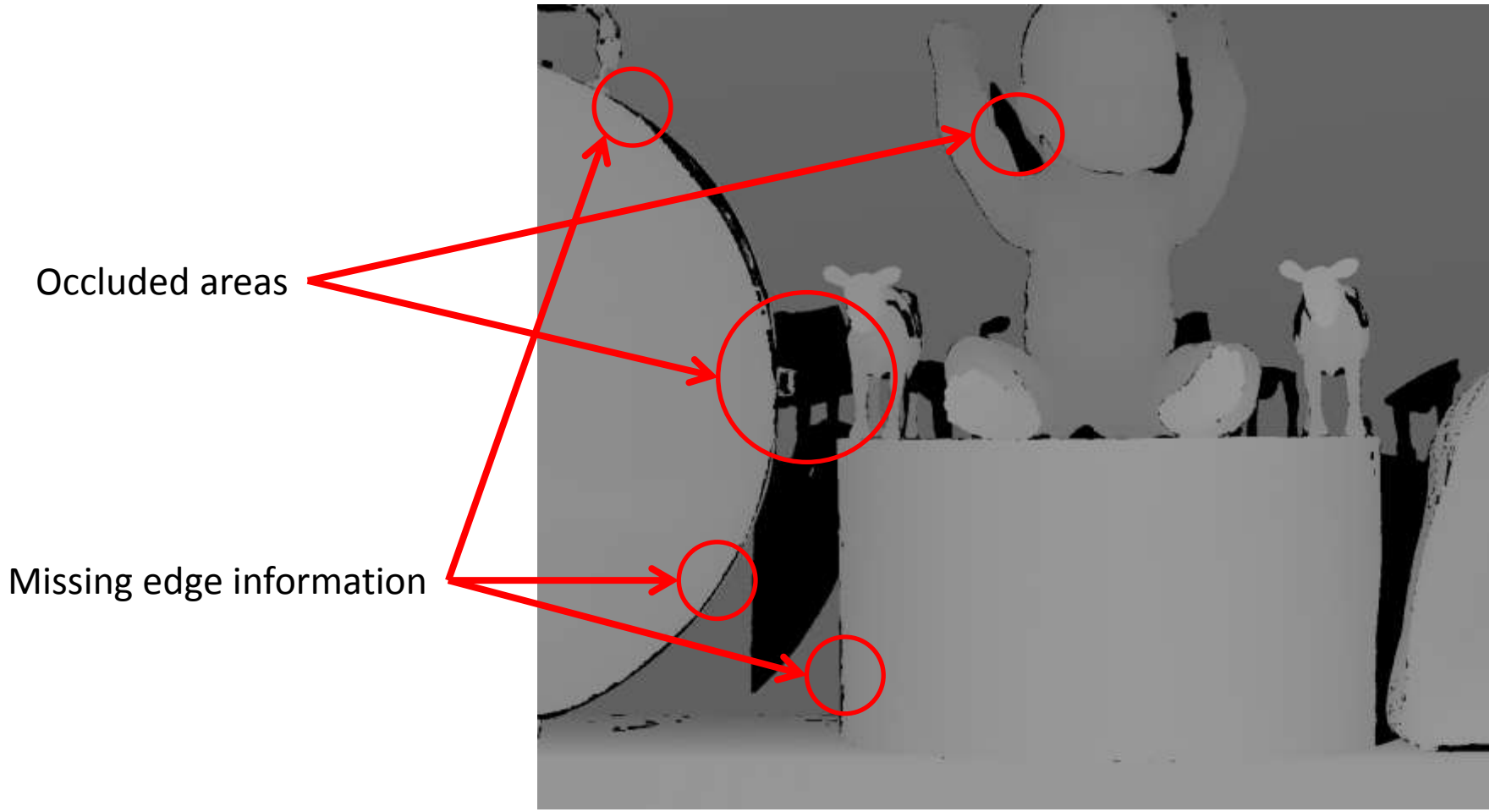
Missing depth information



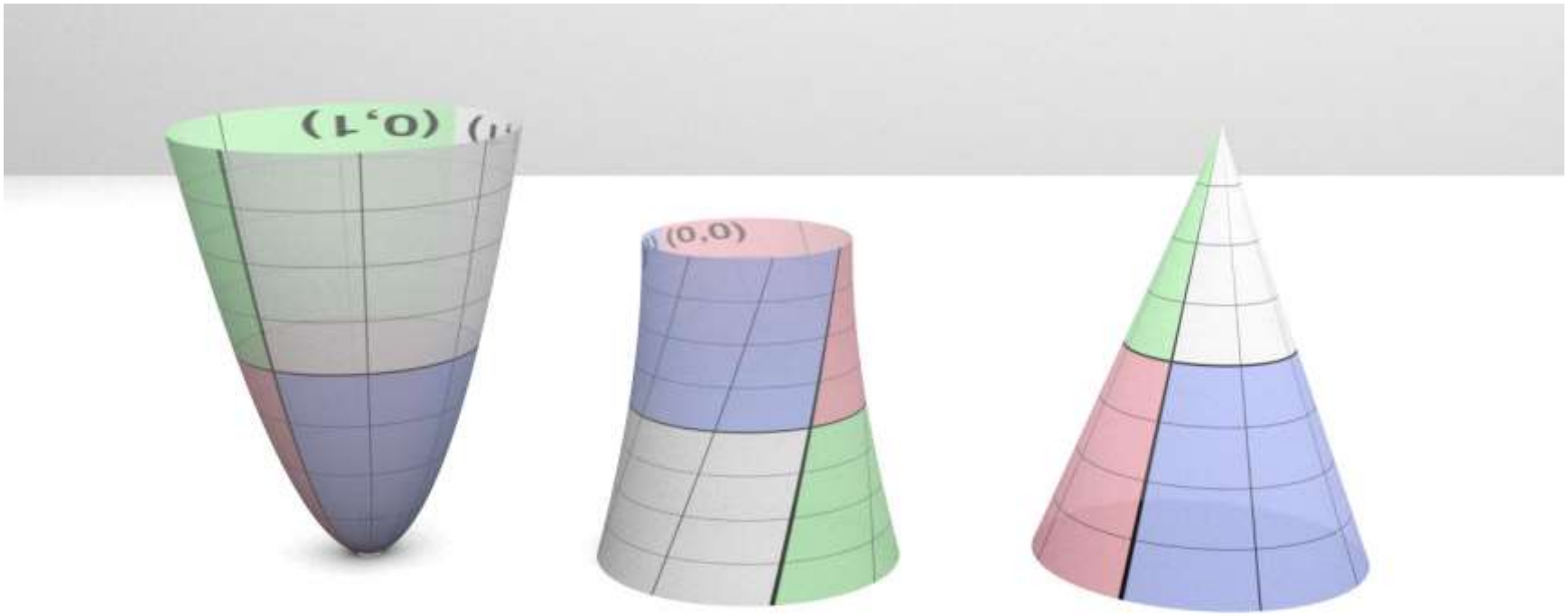
Missing depth information



Missing depth information

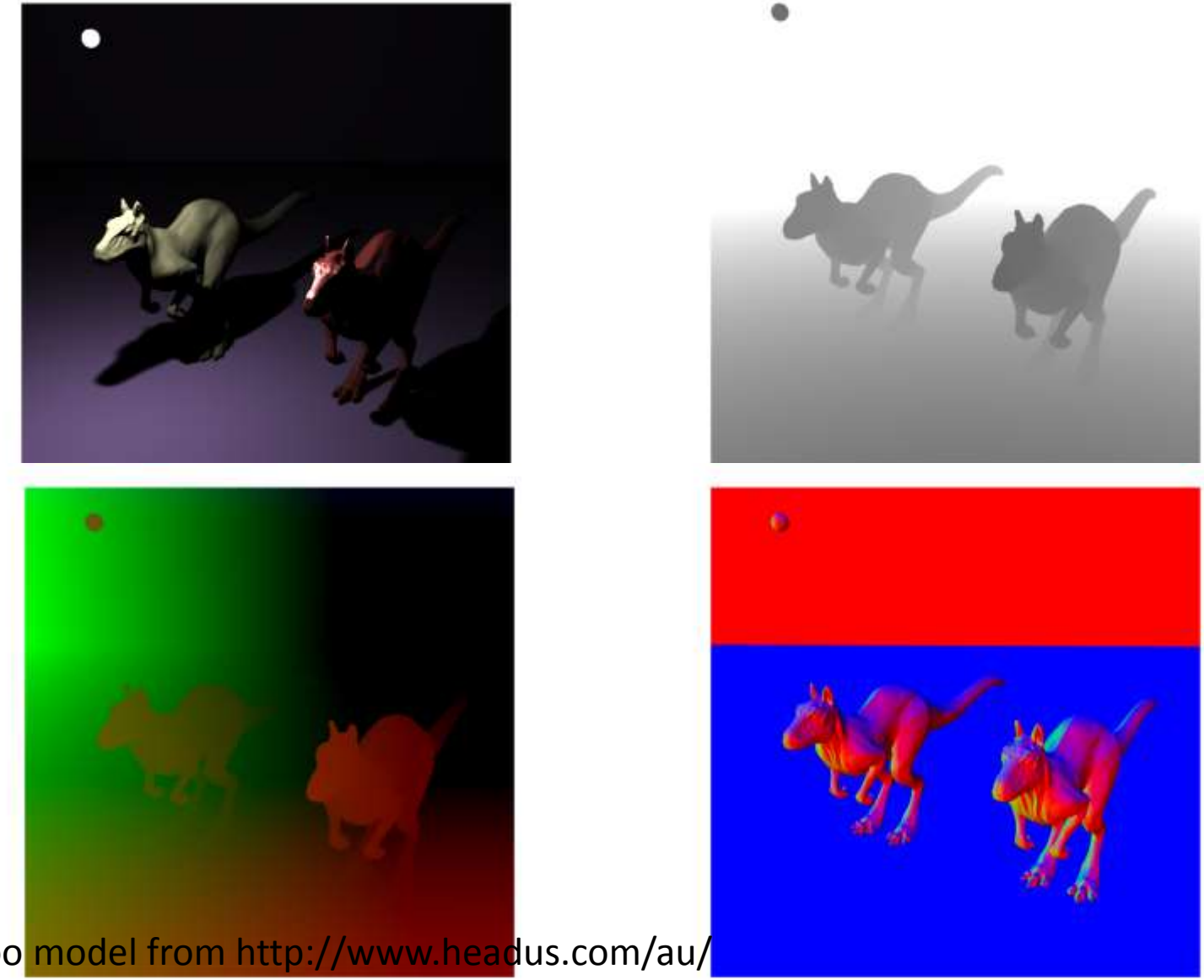


Components: Physically Based Rendering



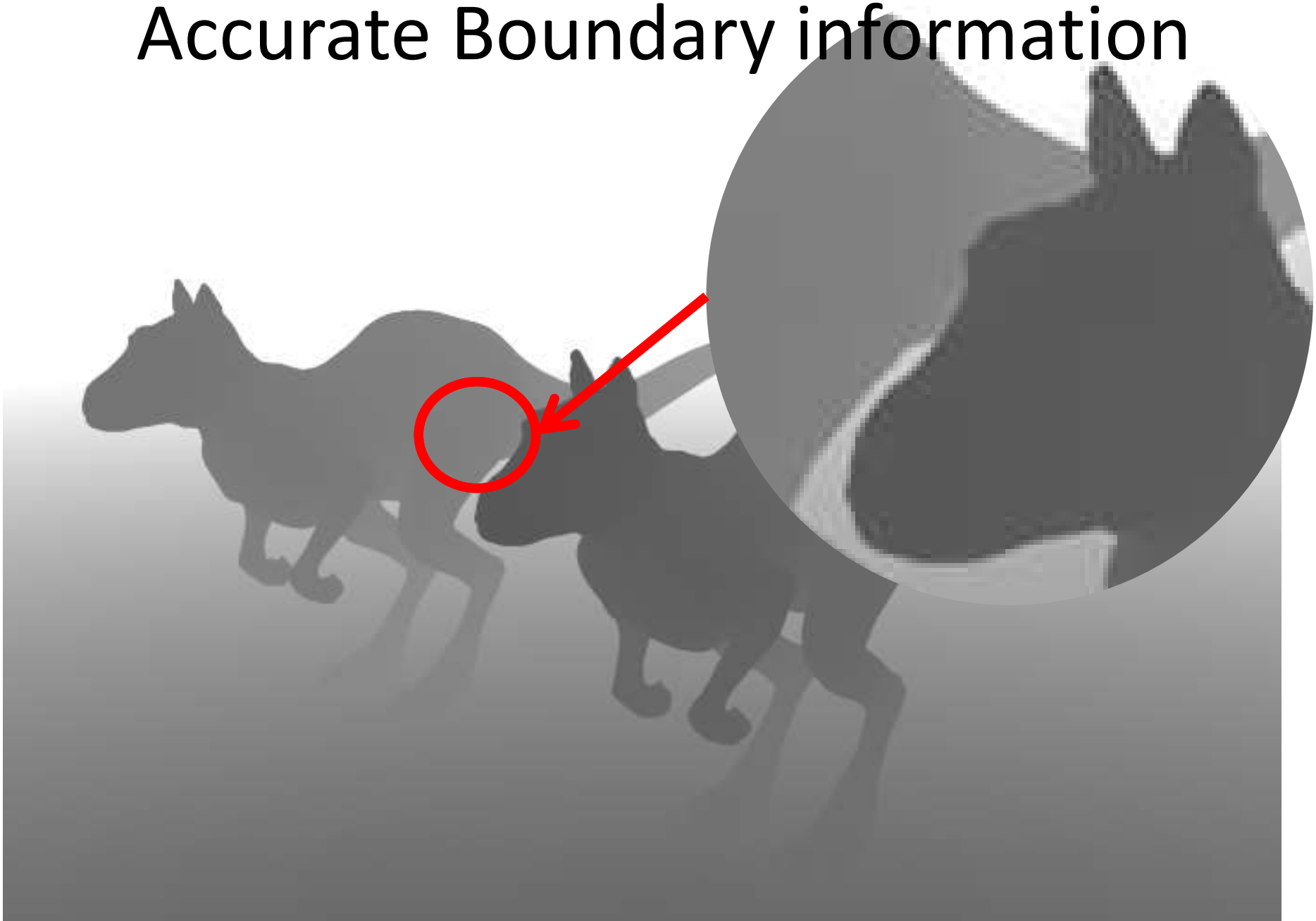
Pharr, Matt, and Greg Humphreys. *Physically based rendering: From theory to implementation*. Morgan Kaufmann, 2010.
http://www.pbrt.org/

Easy access to image information

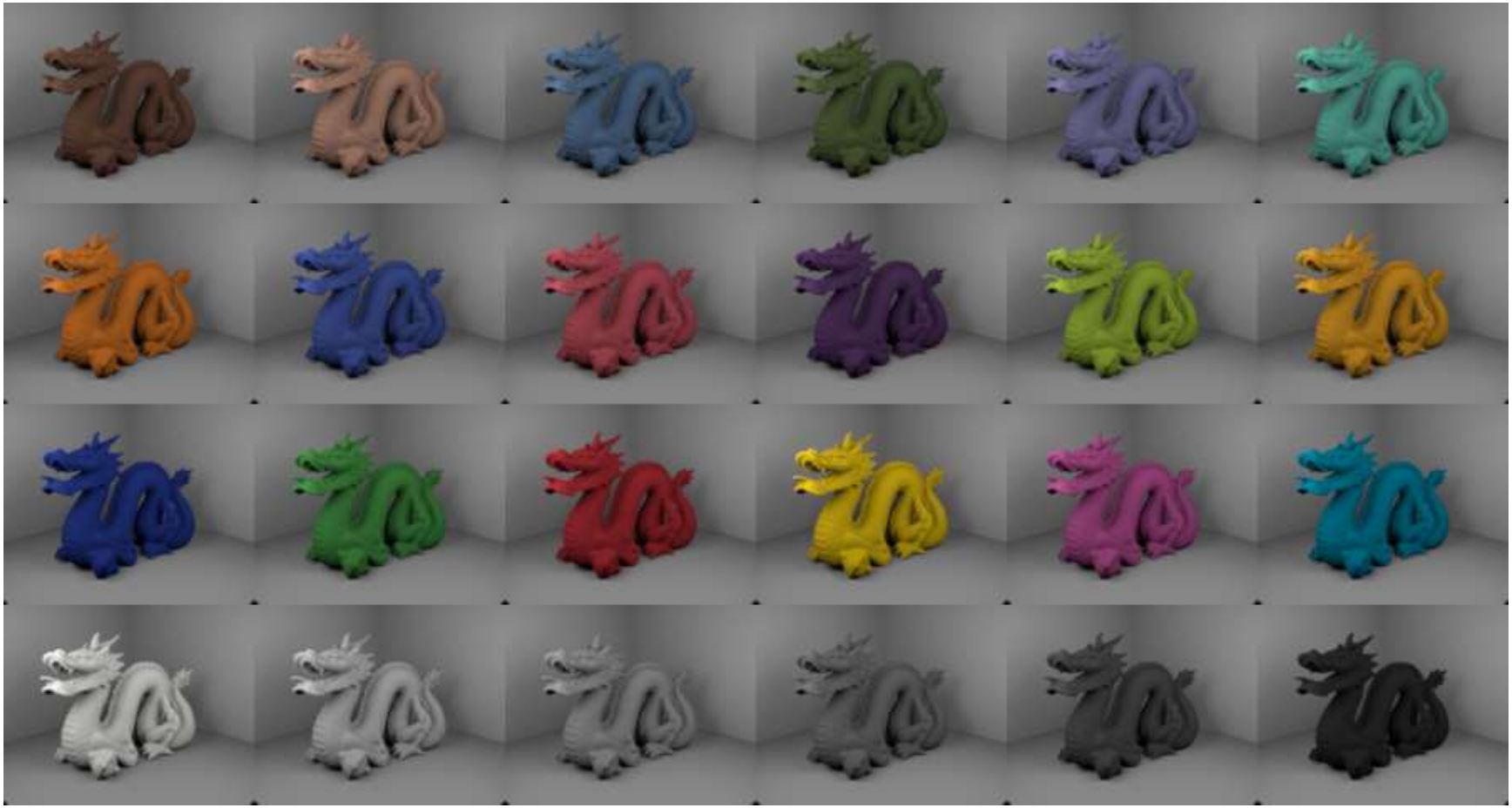


Killeroo model from http://www.headus.com/au/

Accurate Boundary information



Simple replication and batching



“Above, PBRT rendered a dragon scene, 24 times, with the dragon's color as a variable.”
Ben Heasly, David Brainard https://github.com/DavidBrainard/RenderToolbox3/wiki/Overview

Batching: Markup

Original PBRT format

LookAt 400 20 30 0 63 -110 0 0 1

Rotate -5 0 0 1

Camera "perspective" "float fov" [39] "float focaldistance" 400

...

Add markup

LookAt <?camera_location?> <?camera_target?> <?up?>

Rotate -5 0 0 1

Camera "perspective" "float fov" [39] "float focaldistance" 400

…

Matlab code

```
scene.camera_location = [ 400 20 30];
scene. camera_target = [ 0 63 -110];
scene.up = [ 0 0 1];

newScript = parseScript(oldScript, scene);
```

Process

1. Scan physical model(s)

2. Create virtual scene

3. Add markup

LookAt <?camera_location?> <?camera_target?> <?up?>

Rotate -5 0 0 1

Camera "perspective" "float fov" [39] "float focaldistance" 400

…

Dragon-photo: C.C. Rodja Trappe http://en.wikipedia.org/wiki/File:Real_Stanford_Dragon.jpg


Thank you.
Not actually rendered with the system as it is a work in progress

Complex information storage

killeroo-simple.exr:

file format version: 2, flags 0x0
channels (type chlist):
B, 16-bit floating-point, sampling 1 1
G, 16-bit floating-point, sampling 1 1
R, 16-bit floating-point, sampling 1 1
Z, 16-bit floating-point, sampling 1 1
left.L0, 32-bit floating-point, sampling 1 1
left.L1, 32-bit floating-point, sampling 1 1
left.L10, 32-bit floating-point, sampling 1 1
left.L11, 32-bit floating-point, sampling 1 1
left.L12, 32-bit floating-point, sampling 1 1
left.L13, 32-bit floating-point, sampling 1 1
left.L14, 32-bit floating-point, sampling 1 1
left.L15, 32-bit floating-point, sampling 1 1
left.L16, 32-bit floating-point, sampling 1 1
left.L17, 32-bit floating-point, sampling 1 1
left.L18, 32-bit floating-point, sampling 1 1
left.L19, 32-bit floating-point, sampling 1 1
left.L2, 32-bit floating-point, sampling 1 1
left.L20, 32-bit floating-point, sampling 1 1
left.L21, 32-bit floating-point, sampling 1 1
left.L22, 32-bit floating-point, sampling 1 1
left.L23, 32-bit floating-point, sampling 1 1
left.L24, 32-bit floating-point, sampling 1 1
left.L25, 32-bit floating-point, sampling 1 1
left.L26, 32-bit floating-point, sampling 1 1
left.L27, 32-bit floating-point, sampling 1 1
left.L28, 32-bit floating-point, sampling 1 1
left.L29, 32-bit floating-point, sampling 1 1
left.L3, 32-bit floating-point, sampling 1 1
left.L30, 32-bit floating-point, sampling 1 1
left.L4, 32-bit floating-point, sampling 1 1
left.L5, 32-bit floating-point, sampling 1 1
left.L6, 32-bit floating-point, sampling 1 1
left.L7, 32-bit floating-point, sampling 1 1
left.L8, 32-bit floating-point, sampling 1 1
left.L9, 32-bit floating-point, sampling 1 1
compression (type compression): zip, multi-scanline blocks
dataWindow (type box2i): (0 0) - (699 699)
displayWindow (type box2i): (0 0) - (699 699)
lineOrder (type lineOrder): increasing y
nSpectralSamples (type int): 31
pixelAspectRatio (type float): 1
screenWindowCenter (type v2f): (0 0)
screenWindowWidth (type float): 1
type (type string): "scanlineimage"

Multi-spectral information

Components: OpenEXR

High-dynamic range image format.

Built-in stereo format.

Multi-layered, can store non-colour information

-Depth
-Position
-‘Normals’

-Local Curvature
-Object ID
-Lighting