SIGGRAPH2007

A Gentle Introduction to Bilateral Filtering and its Applications

10/10: Conclusions

Jack Tumblin – EECS, Northwestern University

The Bilateral Filter

- As Simple as
  Weights from TWO Gaussian Functions;

- Has deep connections to PDE formalisms,
  shock-forming, heat flow, and diffusion

- Speed? several *very fast* versions

Bilateral Filter

GOALS are Ambitious & Subjective, but

- Noise Removal
- “Edge-Preserving Smoothing”
- Locally Weighted Averaging with Outlier Rejection
- Visual Separation of ‘fine details’ and ‘large features’

METHODS are Simple & Practical

- Bilateral Filter: doubly-weighted local average,
  High weights only for ‘nearby’, ‘similar’ values
- YOU set parameters of what is ‘nearby’,
  of what is ‘similar’

VERY Broad Range of Applications:

- any task where ‘edges’ and ‘similarities’ carry useful information
- data of arbitrary dimensions;
  M to N, time, color, image vector-spaces, etc,
- even on manifolds →3D meshes, etc.

Explosive Growth: *6* New Papers Here

SIGGRAPH 2007: don't miss these new works!

- *Image Deblurring with Blurred/Noisy Image Pairs* — L. Yuan, et al.
- *Multiscale Shape and Detail Enhancement from Multi-Light Image Collections* — R. Fattal et al.
- *Joint Bilateral Upsampling* — J. Kopf et al.
- *LDR2HDR: On-the-fly Reverse Tone Mapping of Legacy Video and Photographs* — A. G. Rempel et al.
- *Factored Time-Lapse Video* — K. Sunkavalli et al.
- *Real-Time Edge-Aware Image Processing With the Bilateral Grid* — J. Chen et al.

Is All the Work Finished?

- Nothing left to explore?

No, No, No!

Bilateral filters raise deep, basic questions;

Answers still vague and tentative..

For example …

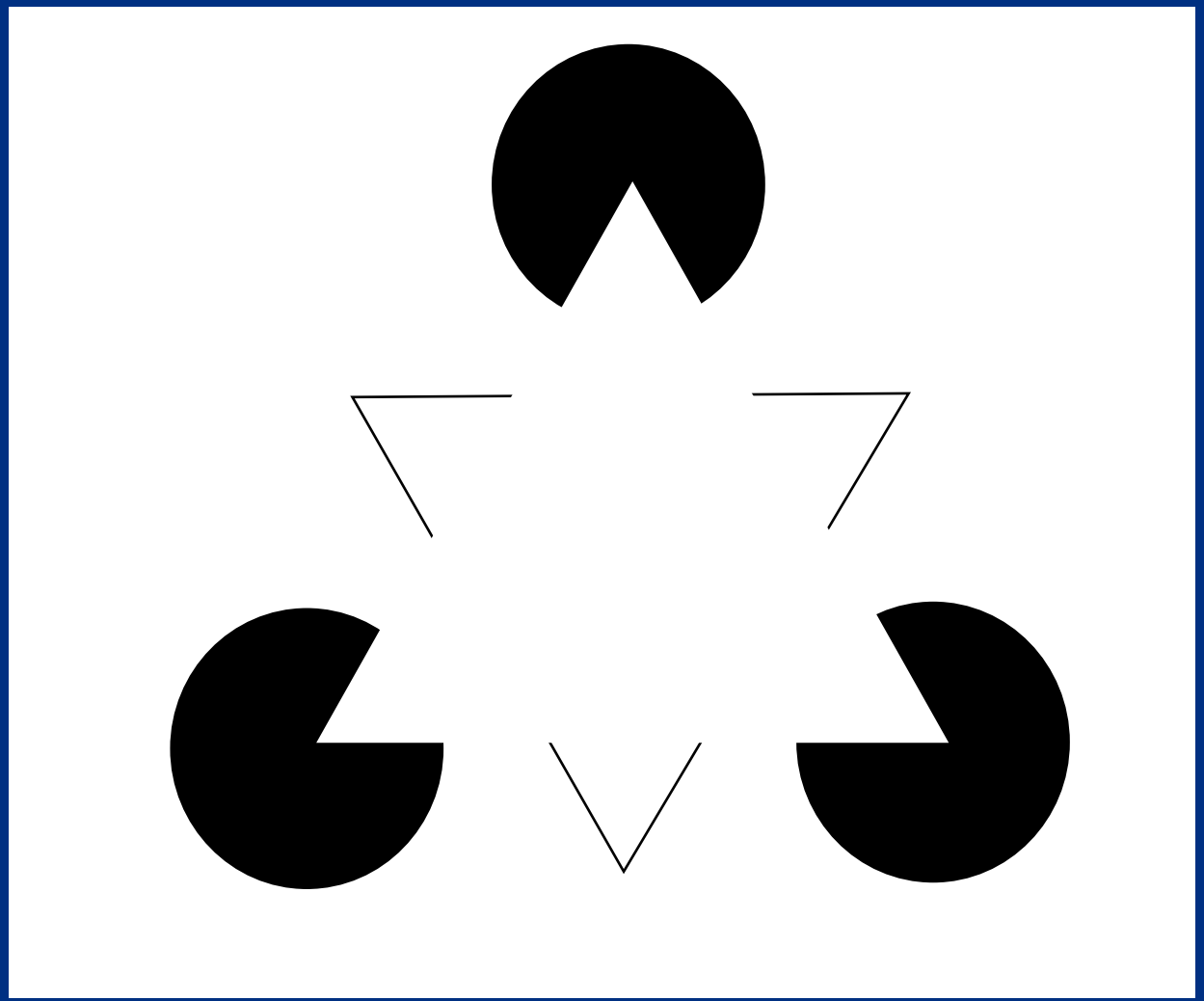
What Is ‘Noise’? What is ‘Texture’?

Wet Sand (Jay Sekora)

What Is ‘Noise’? What is ‘Texture’?

Human Skin (Ken Perlin)

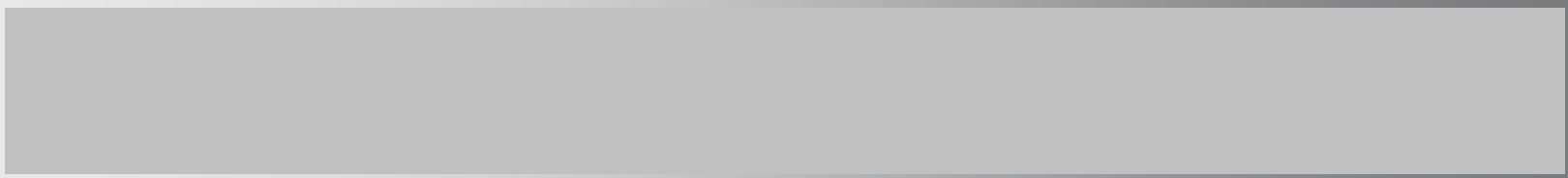
What Is an ‘Edge’ in Human Vision?



Illusory Contours (G. Kanizsa, 1955)

Does *absolute* intensity matter?

Often, Perceived Intensities $\neq$ Pixel Values:



Example: 'Simultaneous Contrast'
Center strip has <u>CONSTANT</u> intensity…

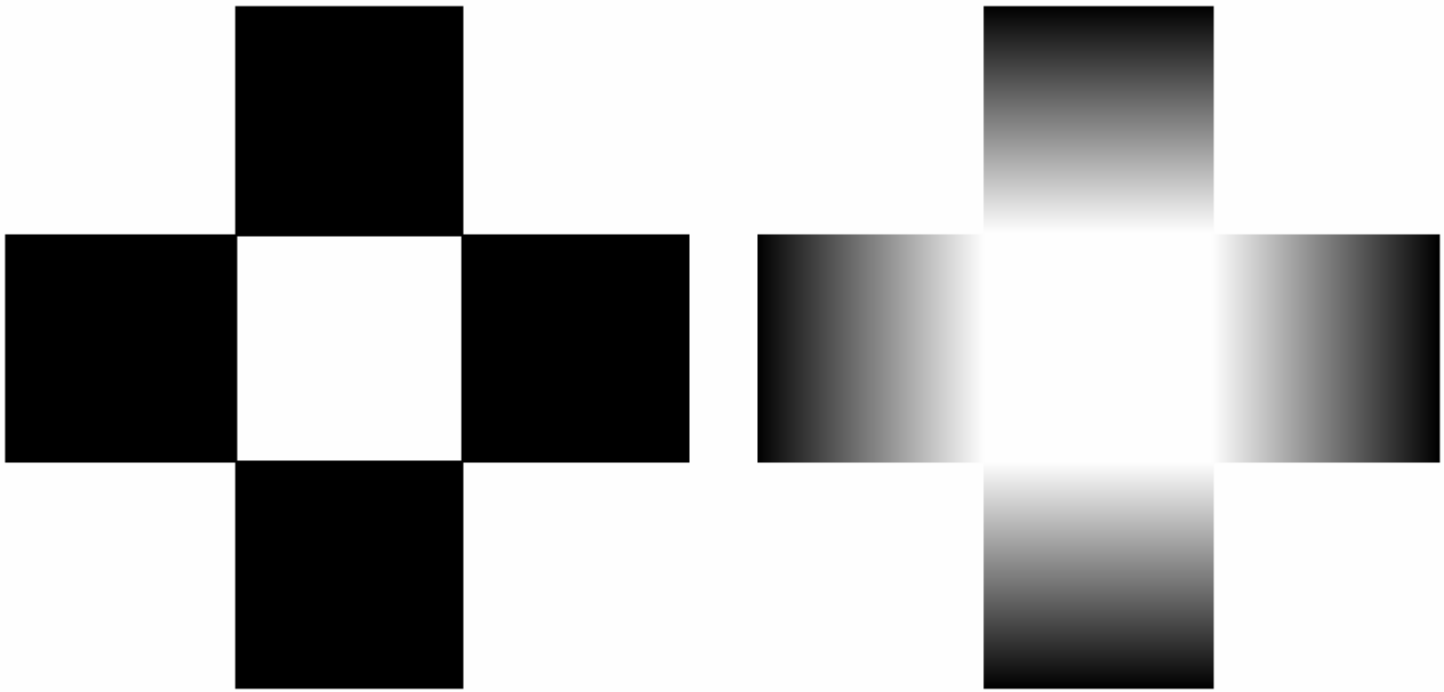
Does *absolute* intensity matter?

Often, Perceived Intensities $\neq$ Pixel Values:

Example: 'Simultaneous Contrast'
Center strip has <u>CONSTANT</u> intensity…

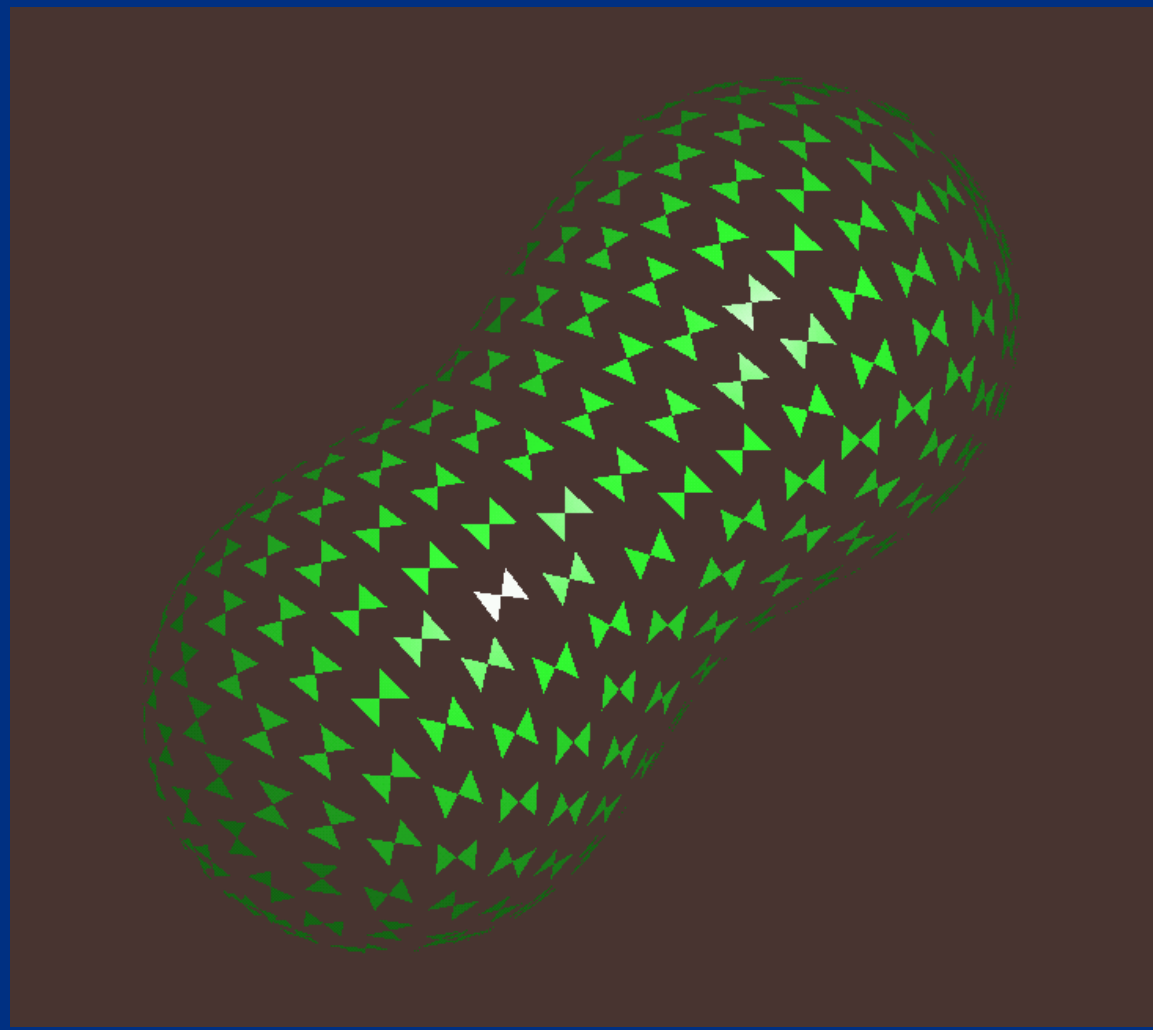
What Is an Illumination Edge?

Sometimes it isn't a large *intensity* change…



What Is a ‘Geometric Edge’ in Images?

3D ‘Peanut’ shape



Some silhouettes are SUGGESTED by shape cues

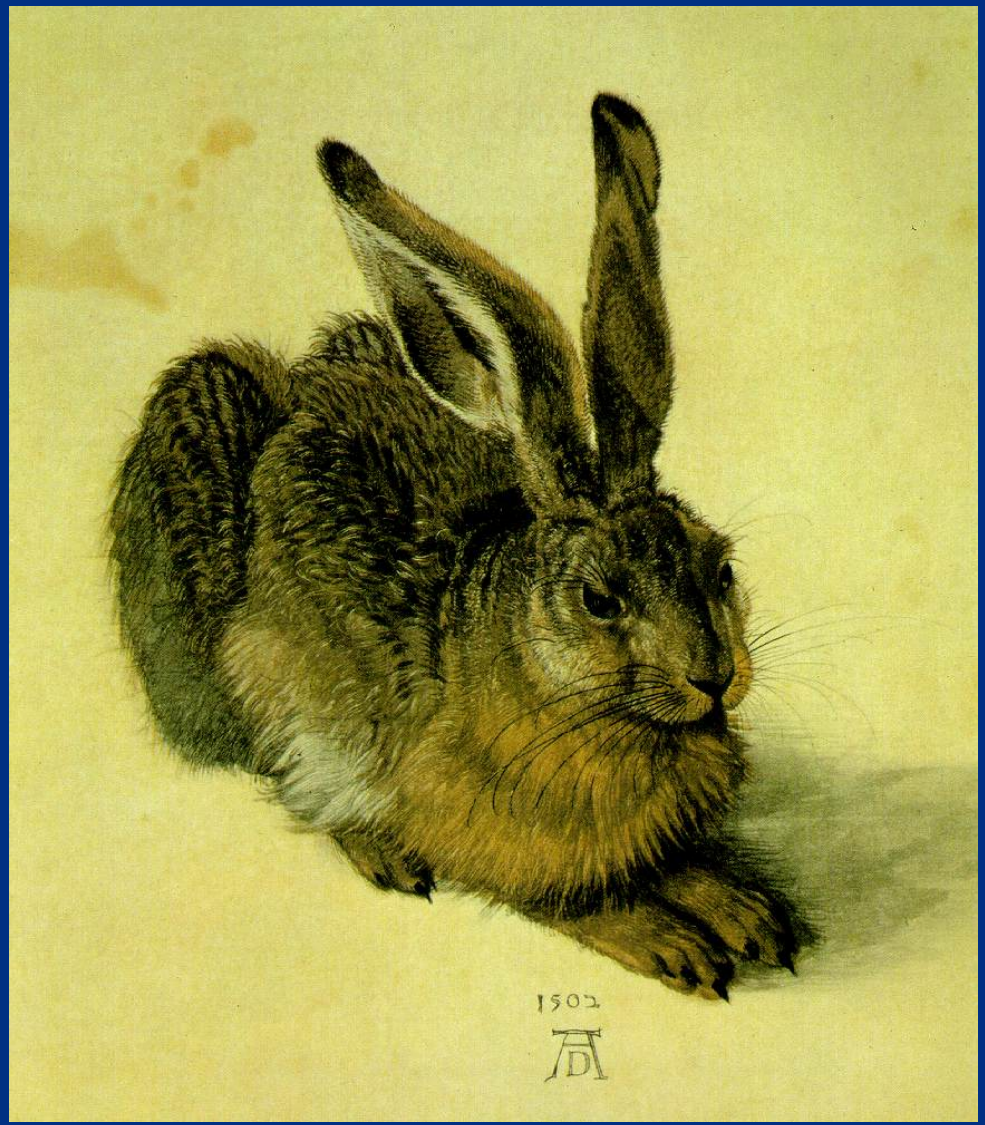
What Is an ‘Edge’ at The Finest Scales?

Scale Problems:

Can’t resolve every hair and fiber in fur…

Long Black Whiskers:

- Visible on Bkgnd, but
- Visible against fur?



Albrecht Durer (1502)

For any perceivable image?

Hmm.

Edge?

Noise?

Regions?

Texture?

Silhouette?

…

http://mfrost.typepad.com/cute_overload/2007/02/backlit_extrava.html

Thank You For Attending!

- Please do fill out a review form, and tell us how we can improve the course…

http://www.siggraph.org/courses_evaluation

- For more in-depth info: links, and all docs:

http://people.csail.mit.edu/sparis/siggraph07_course/

Course Evaluations

http://www.siggraph.org/courses_evaluation

4 Random Individuals will win an ATI Radeon™ HD2900XT

SIGGRAPH2007

END