

ITS 102: Visualize This!



High Dynamic Range Imaging

Klaus Mueller

Computer Science Department

Stony Brook University

Problem: Dynamic Range Gaps

Dynamic range of the natural world:

100 000 000:1

Dynamic range the eye can accommodate in a single view:

10 000:1

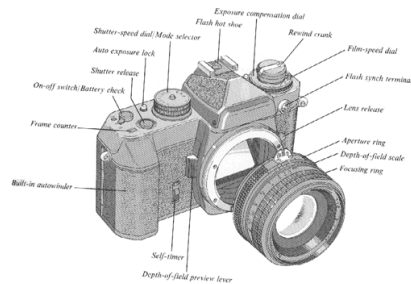
Dynamic range a typical monitor can display:

100:1

Dynamic range a typical camera can capture:

100:1

Primer on Cameras



Aperture: opening size of the lens shutter

- the smaller, the sharper the picture (but the less light gets through)

Exposure time: time the lens shutter is open

- the smaller, the less light gets to the film (CCDs on digital cameras)
- too much light will saturate the film (CCDs)
- but low-light features will require long exposure times to get captured
- conflicting goals when low- and hi-light features are present in scene

Long Camera Exposure



captured the interior well, but the outside is too bright...

Short Camera Exposure



captured the outside well, but now the interior is dark...

Medium Camera Exposure



everything is somewhat present, but not very detailed

What Now...

OK.. now we have three images that have captured all the detail of the scene

- but we want to visualize it all in one picture, not three
- we need some way to merge these three pictures
- this is the domain of *High Dynamic Range Imaging (HDR)*

How does HDR work?

Two methods:

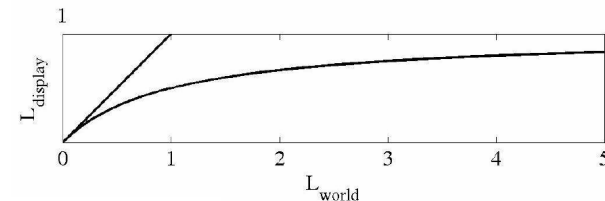
- somehow compress the large range into a small, displayable range
- look at small neighborhoods and try to maximize contrast in each
- the first is a *global* method, the second is a *local* method

This is also often called *tone mapping*

Methods

Global methods:

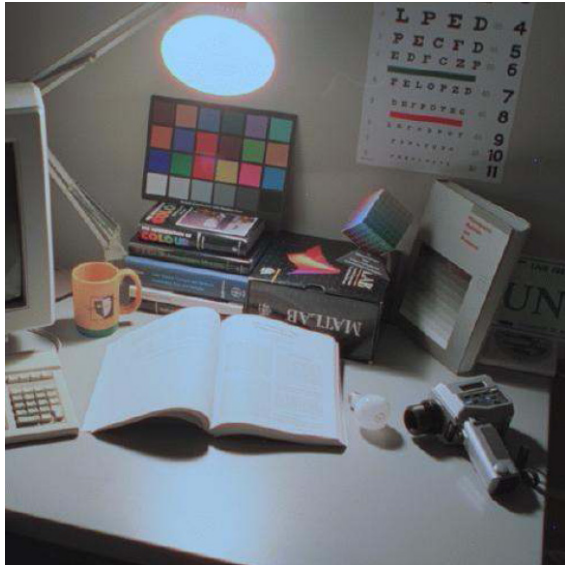
- scale each pixel according to a fixed curve
- the key issue is here: the shape of the curve



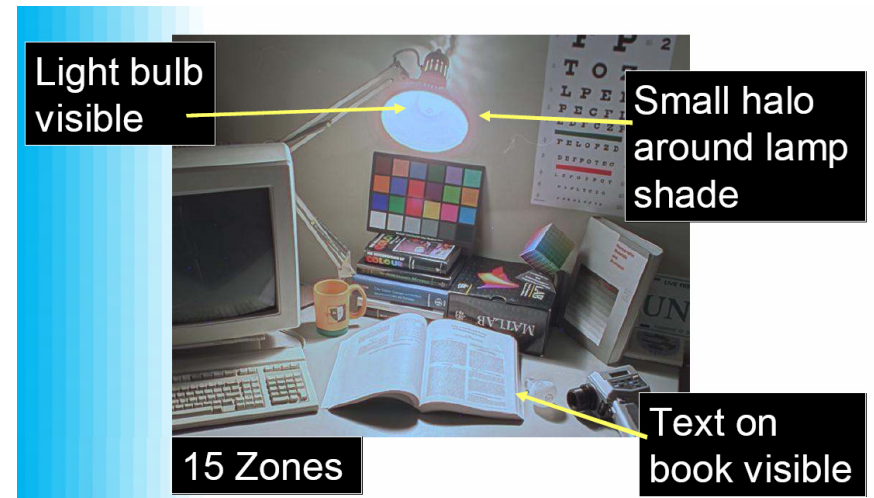
Local methods:

- group small neighborhoods by their average value
- scale these averages down
- add detail back in

Comparison: Global Method



Comparison: Local Method



Result With Earlier Example



Example: Grand Canal



Example: Grand Canal



Example: Grand Canal



Example: Grand Canal



Example: Foyer



Example: Foyer



Example: Foyer



Example: Foyer



Example: Stitched Panorama



Example: Tone-Mapped St. Mark's Square



References

HDR has become a popular technique

Some of the key HDR researchers are:

- P. Debevec, E. Reinhard, G. Ward, M. Ashikhmin, J. Tumblin, and others

Image examples in this talk were taken from

<http://www.hdrsoft.com>

Let's try out their (free) demo software

<http://www.cs.sunysb.edu/~mueller/teaching/its102>