HDR Video goes Mobile

Alexandre Chapiro and Tássio Knop

Digital Photography

- Photographers use "dynamic range" for the luminance range of a scene being photographed, or the limits of luminance range that a given digital camera can capture

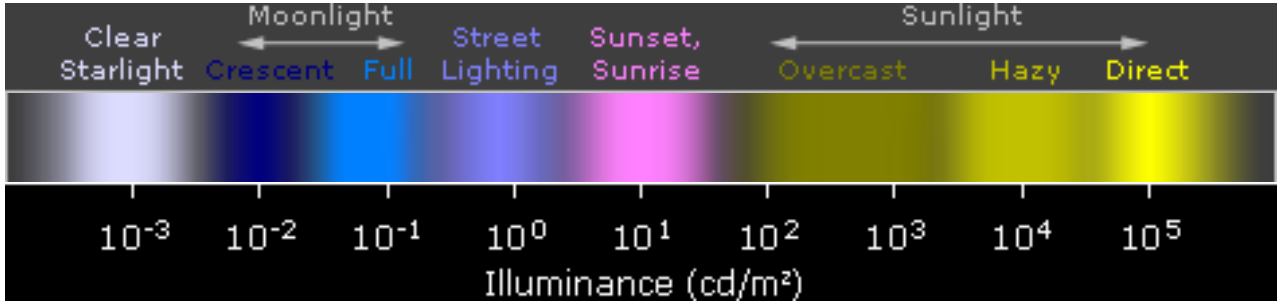


Image: http://www.cambridgeincolour.com/tutorials/dynamic-range.htm

Digital Photography

- The dynamic range of sensors used in digital photography is many times less than that of the human eye and generally not as wide as that of chemical photographic media.
  - Algorithmic solutions

High Dynamic Range - HDR

- Technique that allows greater dynamic range than current standard photography methods.
- Can be done by merging of multiple “low dynamic range” (standard) photographs.

Combined Exposure for HDR

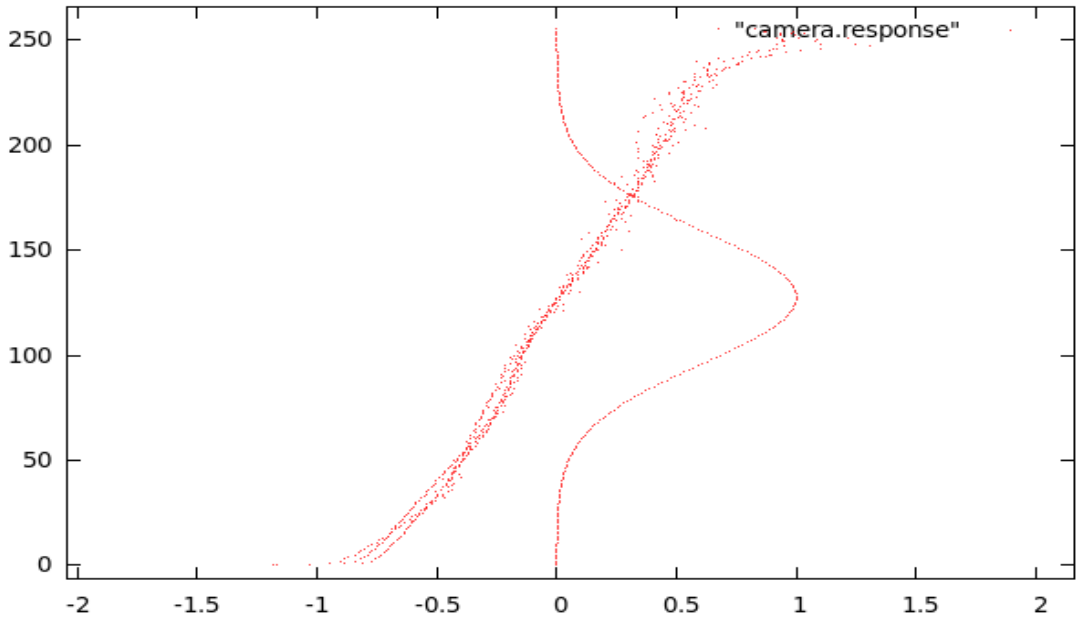
HDR from several Exposures

- Several images are taken, with different exposures.
- Each pixel has a “good” value on at least one image.
- 

HDR from several Exposures

Camera response curve is built, based on the known Exposure Time and “good” Pixel Values.

- ISO stays fixed. (non-linear response with ISO variation).



Actual Nokia N900 camera response for a certain ISO.

Tone Mapping

- Normal display methods (monitors, projectors, printers …) have Low Dynamic Range, unable to reproduce HDR.

- Need “Tone Mapping” algorithms to reduce radiance contrast (and try to preserve the original scene).

Tone Mapping

Original captures

Displayable result

HDR displays?

Tone Mapping

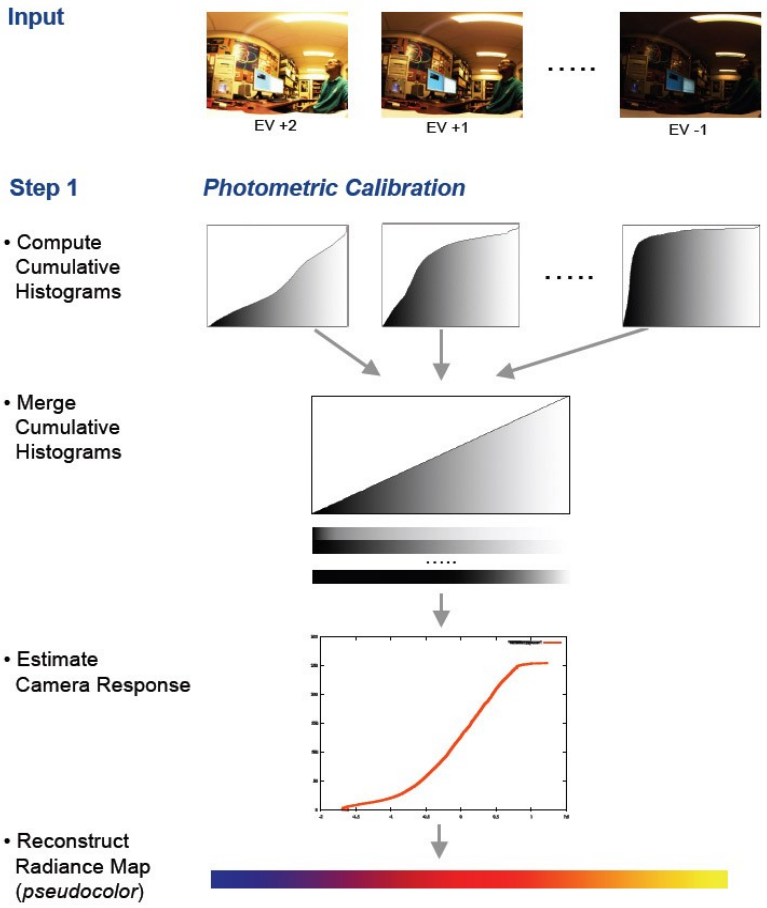
HDR image

HDR Video

- Object movement.
- Camera movement.
- Needs a good framerate.
- Illumination varies.

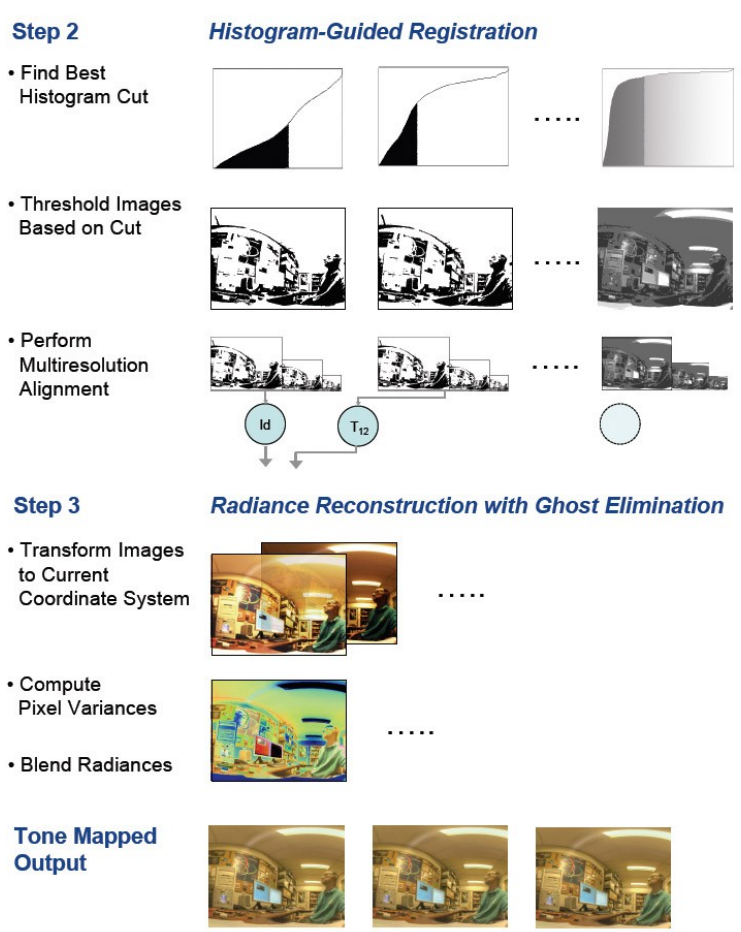
Luiz Velho's Method

- Cumulative histograms.
- Brightest pixel correlation.
- Camera response.
- Obtains a radiance map.



Luiz Velho's Method

- Binarize image in order to compensate camera movement.
- Builds HDR image from radiance map.
- The result is a video with the same framerate as the LDR captures.



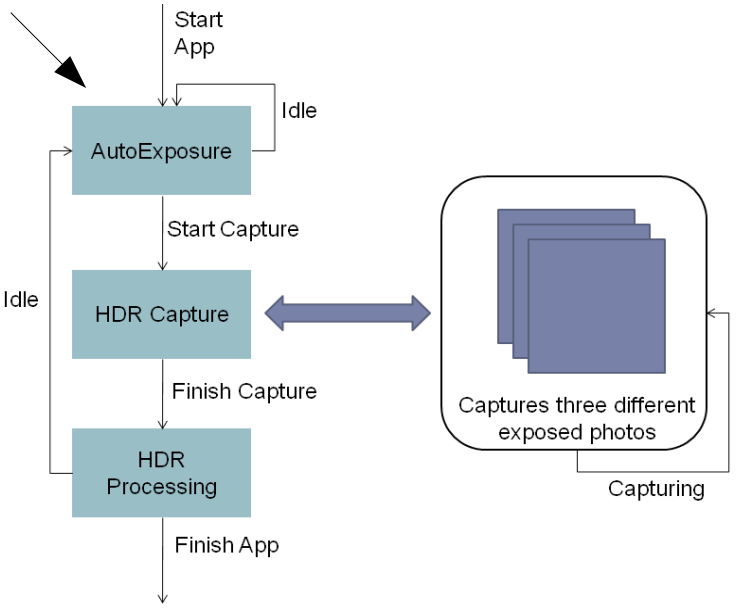
Mobile HDR Video

- FrankenCamera and FCam API [1]
- A fully programmable camera. Exposure, ISO, Flash, etc. can be controlled
- Programmable in C++ with QT.
- Also works on the Nokia N900 smartphone.

  (That has a surprisingly good camera)

HDR Video goes Mobile

- Our method automatically adjusts exposure time and gain for best results.
- Motion estimation is based on histograms.
- Resulting video has same framerate as LDR captures.



Technical challenges

- Goals:
  - Good framerate
  - High quality videos of arbitrary duration
- Limitations:
  - Mobile devices still have limited processing power and memory

- 600 MHz ARM processor
- 256 MB RAM

Technical challenges

- Solutions:
  - Capture short videos
  - Post-process the captured frames
- Other possibilities:
  - Hardware video encoding
  - Faster, bigger memory

- 600 MHz ARM processor
- 256 MB RAM

Results

Please see the project's website, at:
http://w3.impa.br/~achapiro/hdr,
And the results video at:
http://w3.impa.br/~achapiro/hdr.mov

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