A Gentle Introduction to Bilateral Filtering and its Applications

SIGGRAPH2007

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- The bilateral filter is becoming in computational photography.

- Many applications with high quality results.

Photographic Style Transfer
[Bae 06]

input

Photographic Style Transfer
[Bae 06]

output

Tone Mapping
[Durand 02]

HDR input

Tone Mapping
[Durand 02]

Cartoon Rendition
[Winnemöller 06]

input

Cartoon Rendition
[Winnemöller 06]

6 papers at SIGGRAPH'07
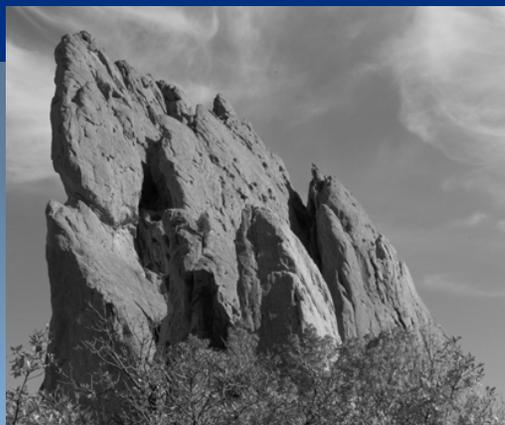
output

Goal: Image Smoothing

Split an image into:

- large-scale features, structure

- small-scale features, texture

Naïve Approach: Gaussian Blur

BLUR

HALOS
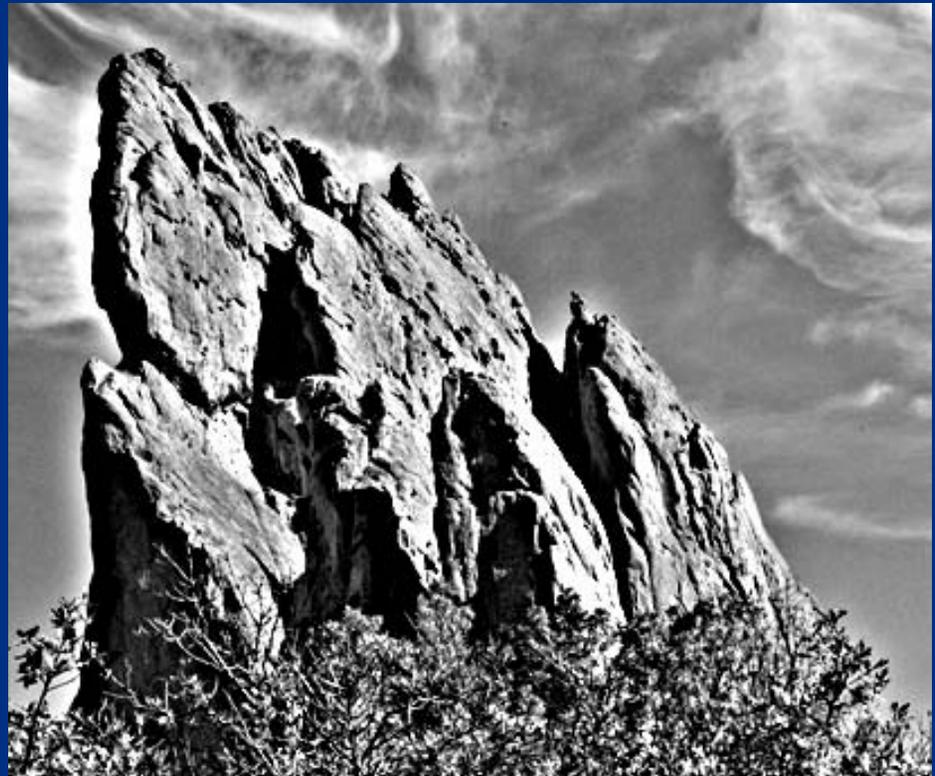

input

smoothed
(*structure, large scale*)

+

residual
(*texture, small scale*)
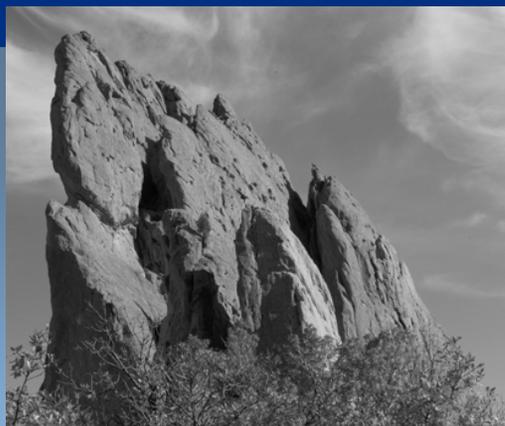
Gaussian Convolution

Impact of Blur and Halos

- If the decomposition introduces blur and halos, the final result is corrupted.

Sample manipulation: increasing texture (residual $\times$ 3)

Bilateral Filter: no Blur, no Halos

input ⇨ smoothed
(structure, large scale)

+ residual
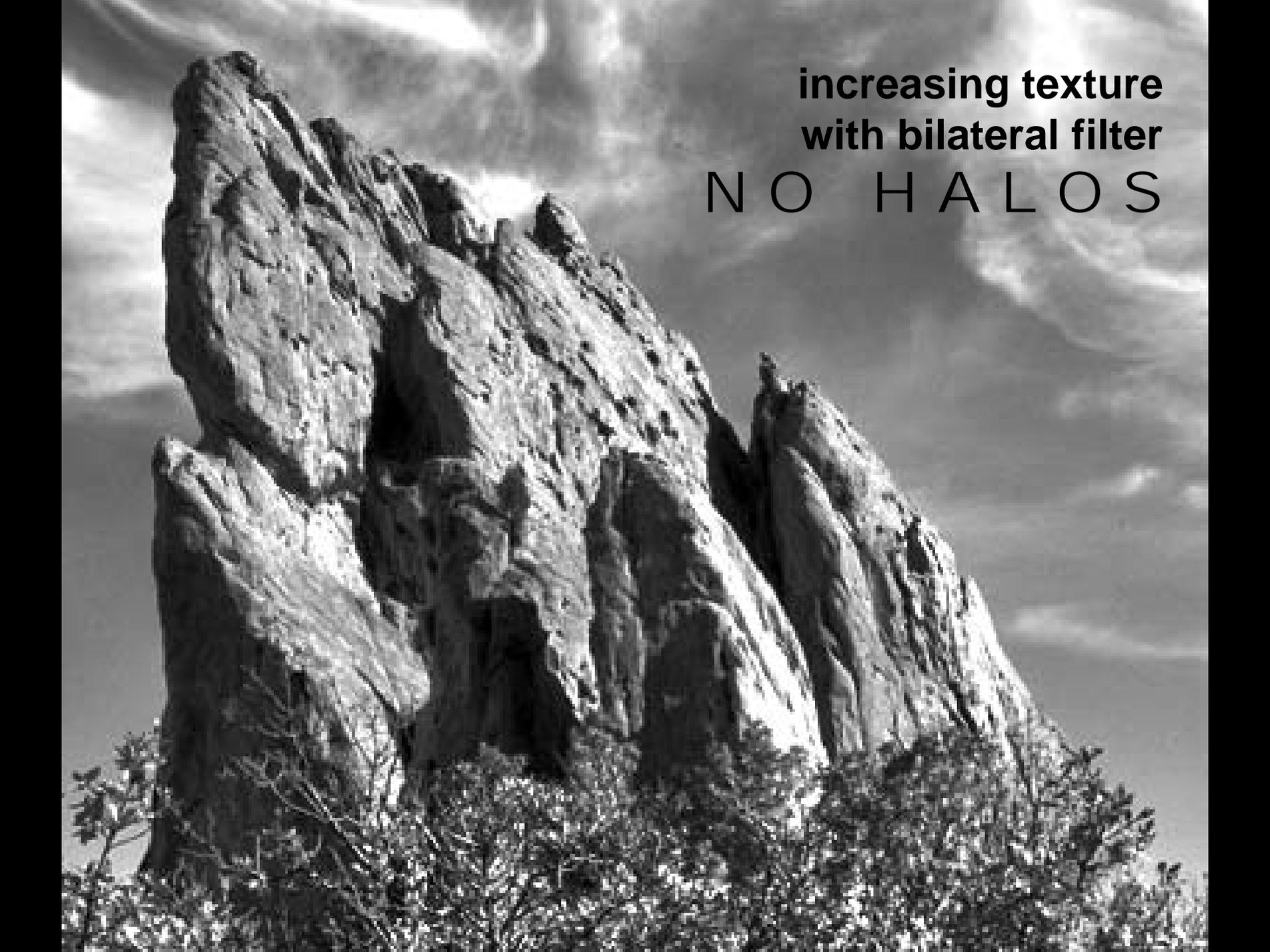(texture, small scale)

edge-preserving: Bilateral Filter

input

increasing texture
with Gaussian convolution
H A L O S

increasing texture
with bilateral filter
N O H A L O S

Many Other Options

- Bilateral filtering is not
  the only image smoothing filter
  - Diffusion, wavelets, Bayesian…

- We focus on bilateral filtering
  - Suitable for strong smoothing used in computational photography
  - Conceptually simple

Content of the Course

All you need to know about bilateral filtering:

- Definition of the bilateral filter

- Parameter influence and settings

- Applications

- Relationship to other filters

- Theoretical properties

- Efficient implementation

Course Material

- Course webpage (google "bilateral filter course"):
  http://people.csail.mit.edu/sparis/siggraph07_course/

  – Detailed course notes

  – Slides (soon)

  – C++ and Matlab code

  – Links

A Gentle Introduction to Bilateral Filtering and its Applications

- From Gaussian blur to bilateral filter – *S. Paris*

- Applications – *F. Durand*

- Link with other filtering techniques – *P. Kornprobst*

BREAK

- Implementation – *S. Paris*

- Variants – *J. Tumblin*

- Advanced applications – *J. Tumblin*

- Limitations and solutions – *P. Kornprobst*