A Gentle Introduction to Bilateral Filtering and its Applications

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- The bilateral filter is becoming ubiquitous 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

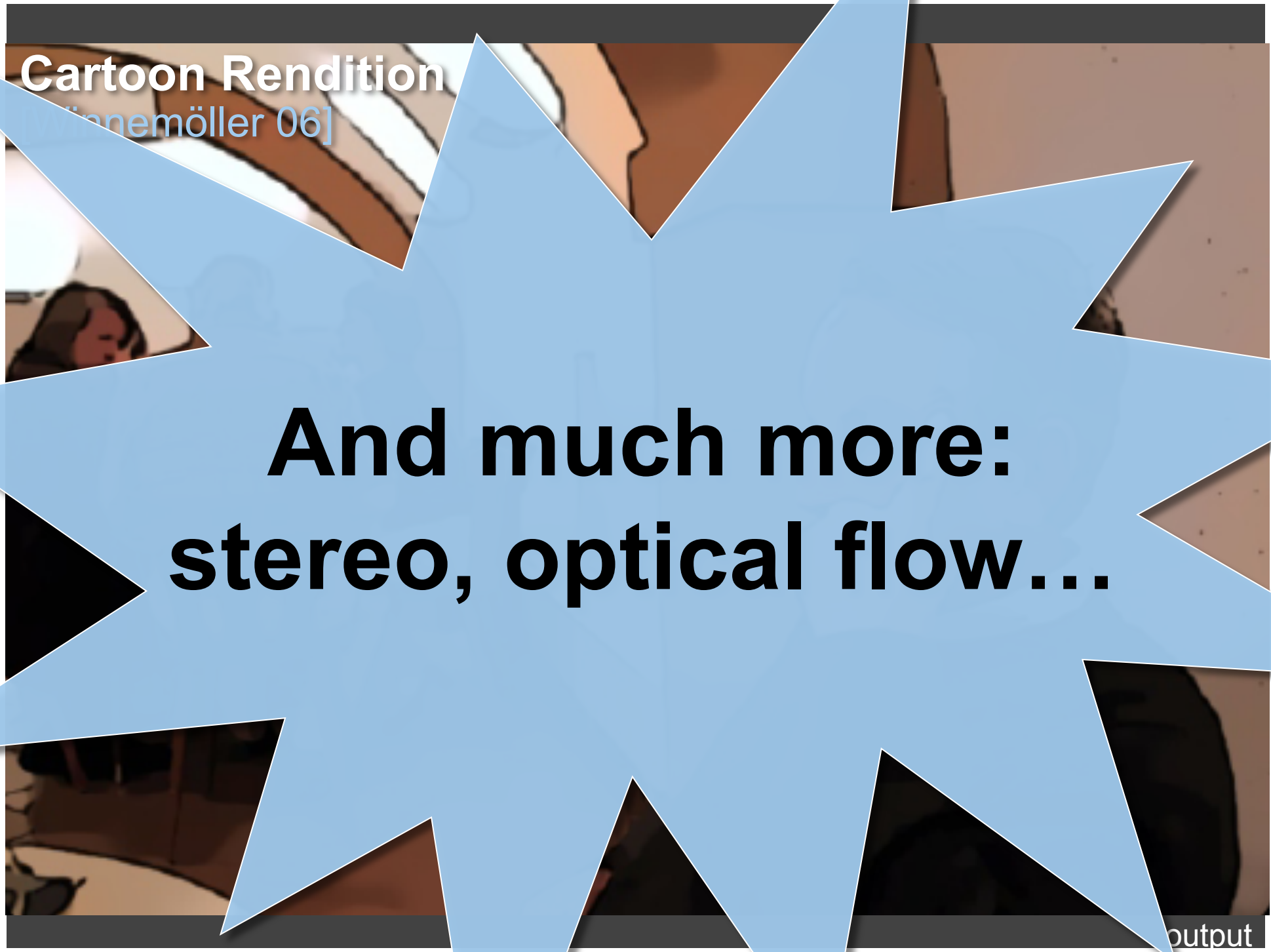
Tone Mapping

[Durand 02]

output

Cartoon Rendition
[Winnemöller 06]

input



And much more: stereo, optical flow…

Goal: Image Smoothing

Split an image into:

- large-scale features, structure
- small-scale features, texture

Naïve Approach: Gaussian Blur

input

BLUR

smoothed
(structure, large scale)

HALOS

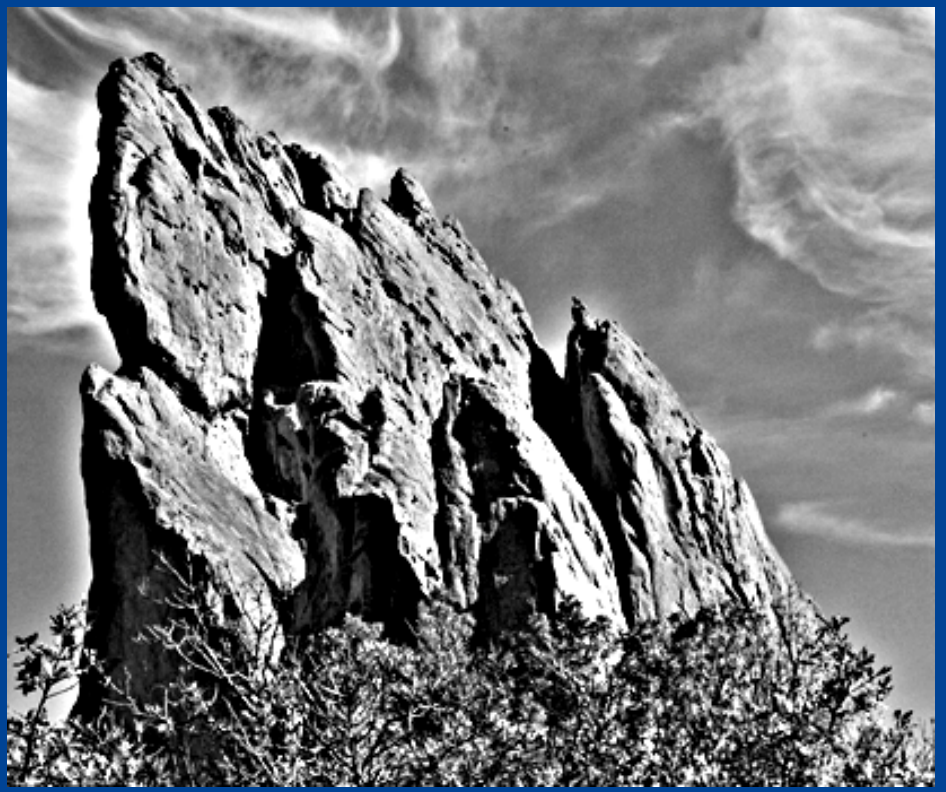
residual
(texture, small scale)

Gaussian Convolution

Impact of Blur and Halos

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

Sample manipulation:
increasing texture
(residual × 3)



Bilateral Filter: no Blur, no Halos

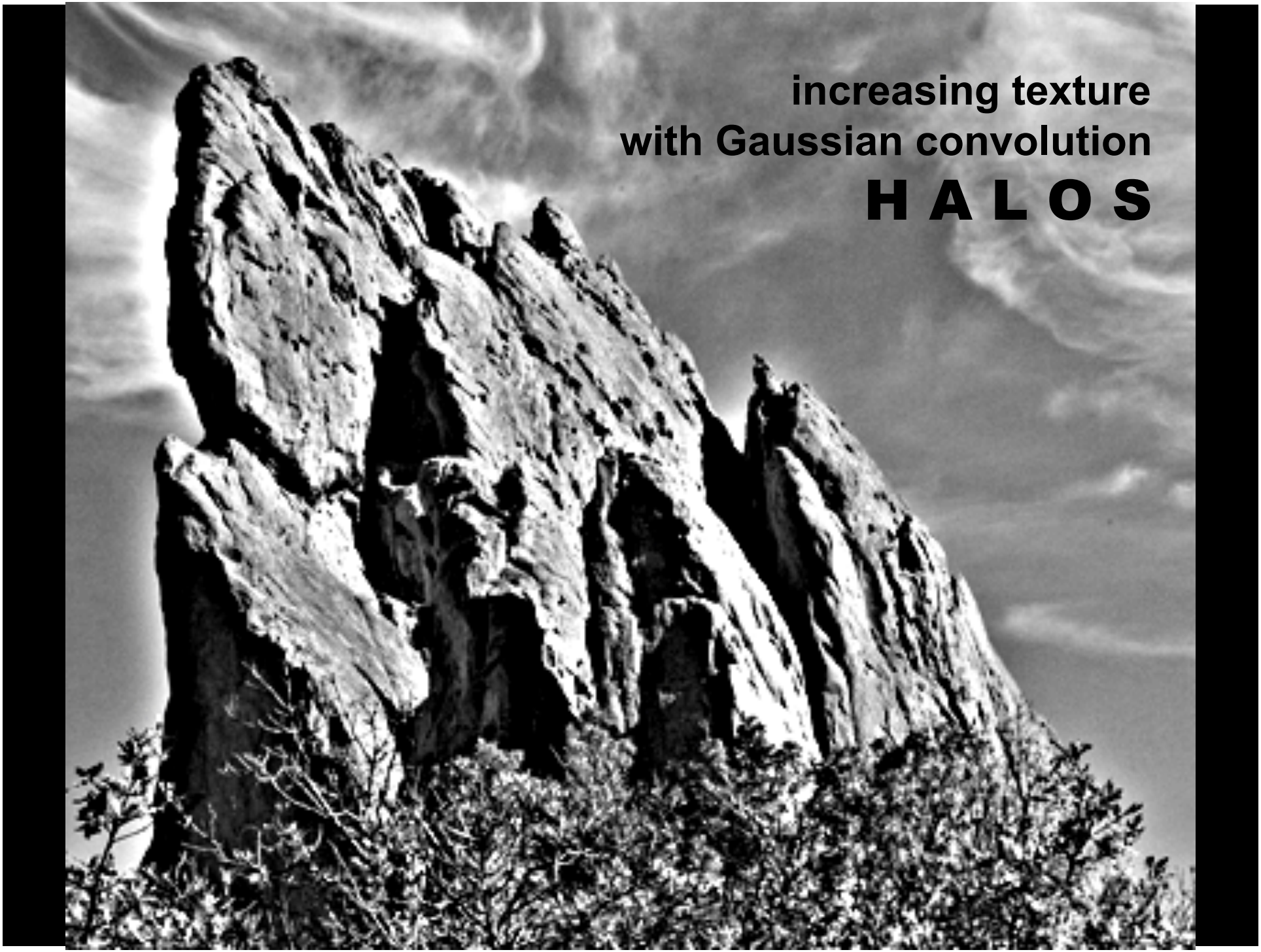
input

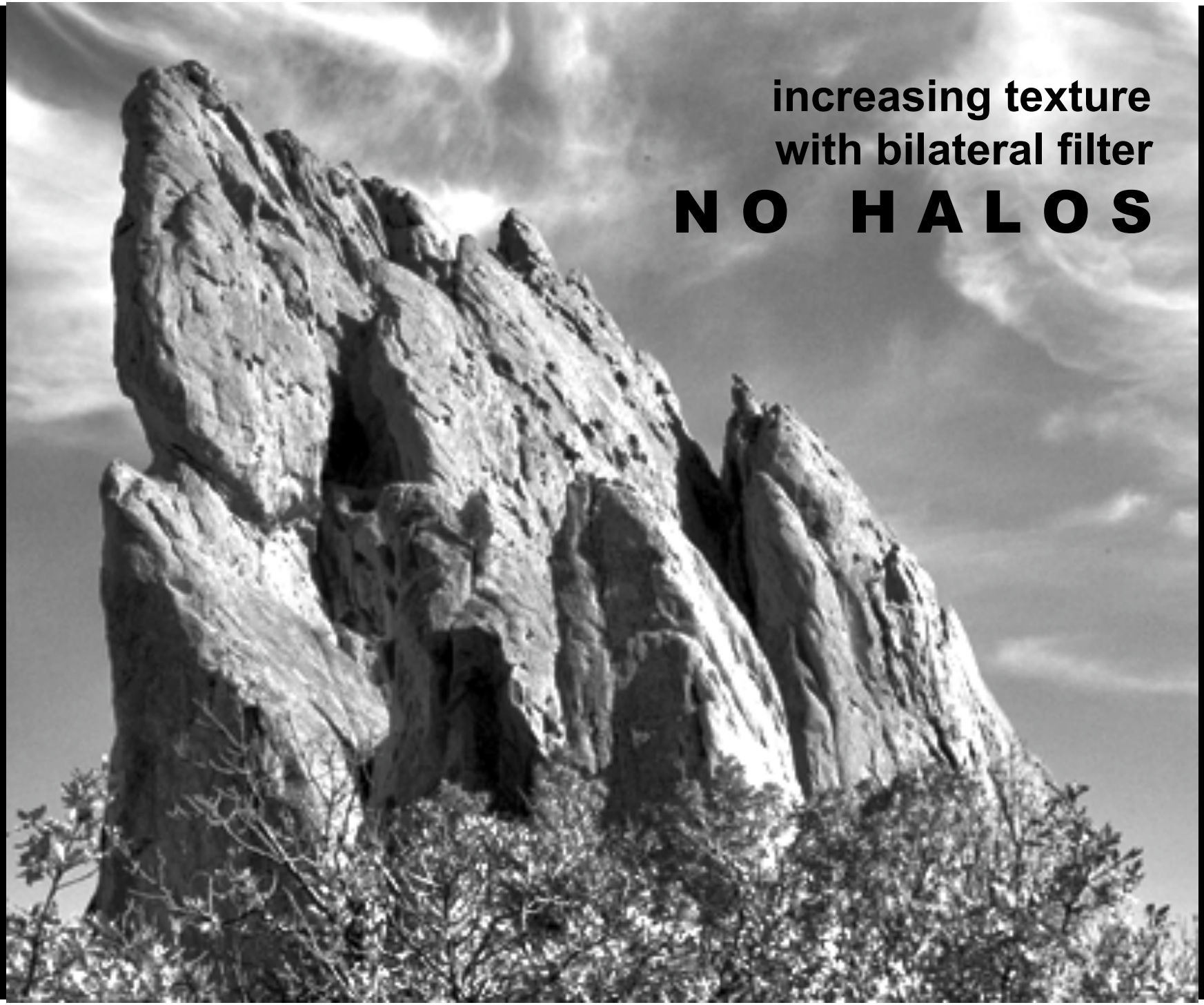
smoothed
(*structure, large scale*)

residual
(*texture, small scale*)

edge-preserving: Bilateral Filter


input


increasing texture
with Gaussian convolution
HALOS


increasing texture
with bilateral filter
NO HALOS

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/bf_course/`
  - Detailed course notes
  - Slides
  - 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*