Local Laplacian Filters: Edge-aware Image Processing with a Laplacian Pyramid

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Presenter: Jing Niu

An Example

- Input:

An Example

- output

Outline

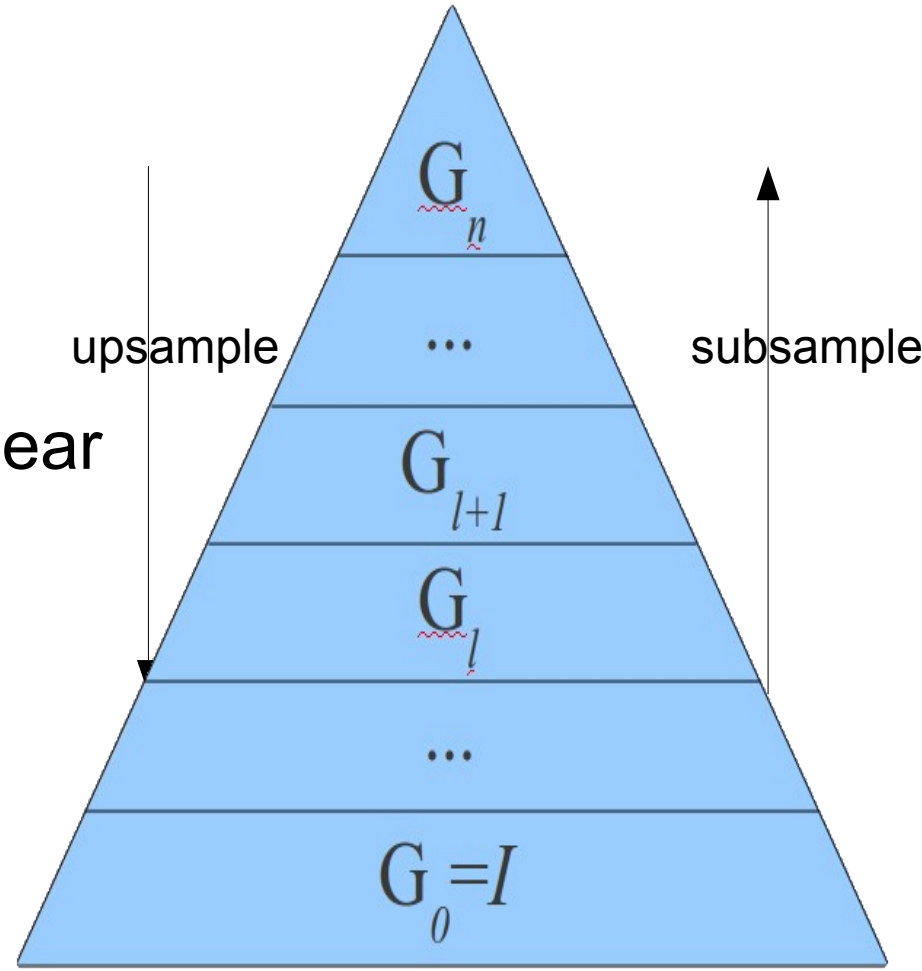
- Motivation
- Laplacian Pyramids
- Local Laplacian Filtering
- Algorithm
- Applications

Motivation

- Belived to be unsuitable for:
  - Representing edges
  - Edge-aware operations (edge-preserving smoothing, tone mapping)
  - Reason:
    - Build upon isotropic, spatially invariant gaussian kernel
- Goal:
  - Flexible approach
  - edge-aware image processing using
    - simple point-wise manipulation of Laplacian pyramids

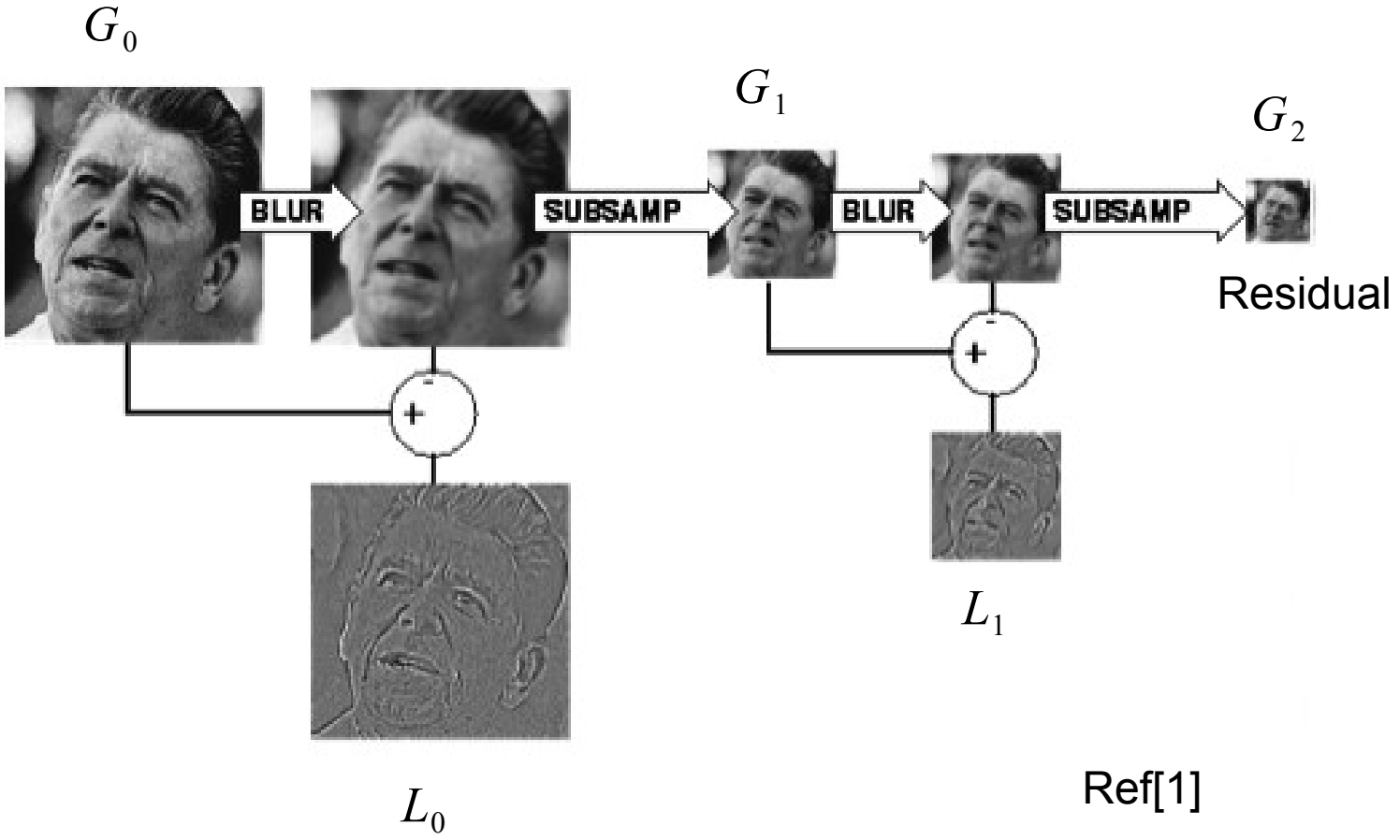
Laplacian and Guassian Pyramids

- Gaussian Pyramid:
  - A set of image levels
  - Represent lower resolution
  - High frequency details disappear



Laplacian Pyramid

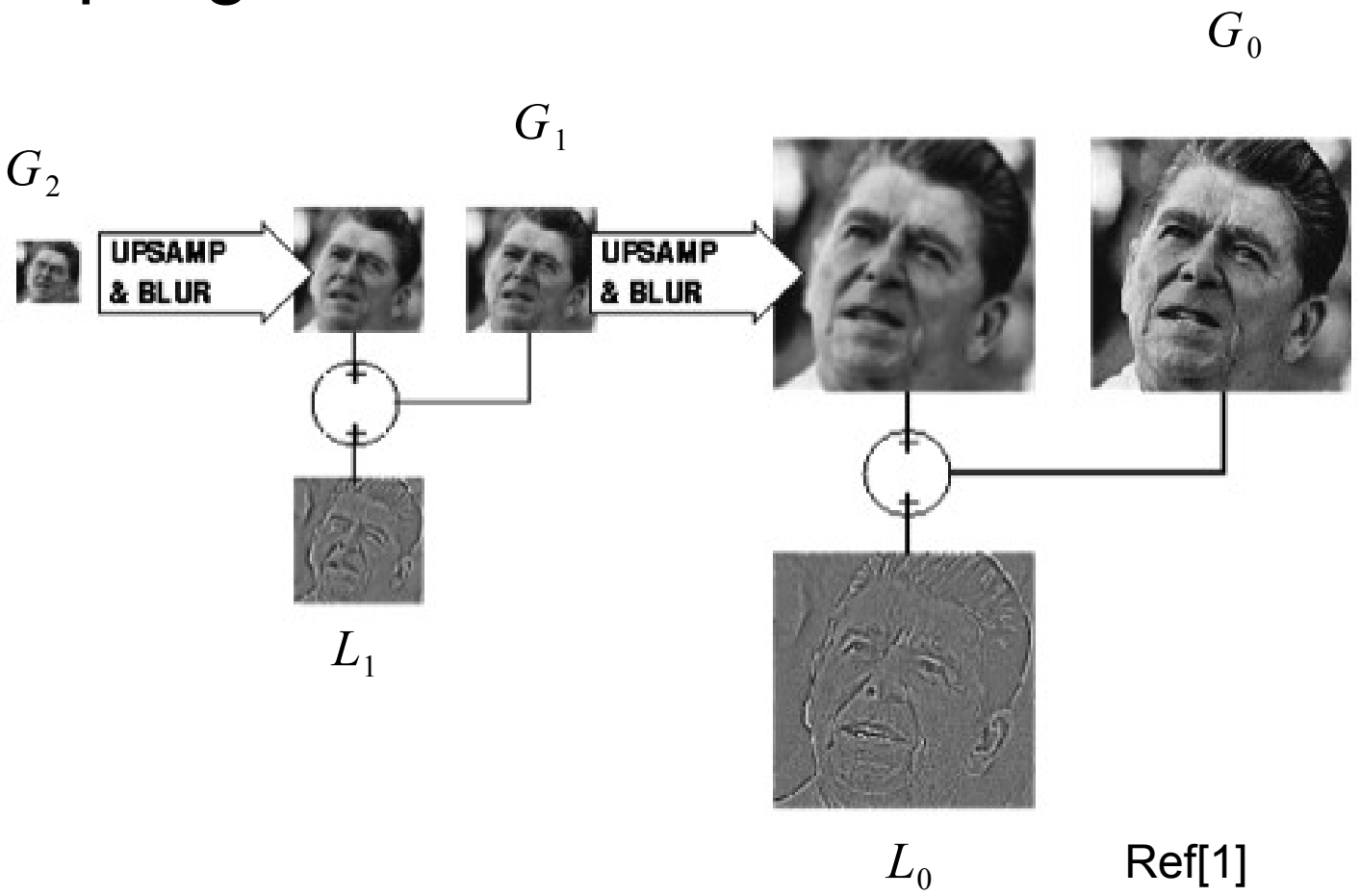
- Downsampling:decomposition



Ref[1]

Laplacian Pyramid

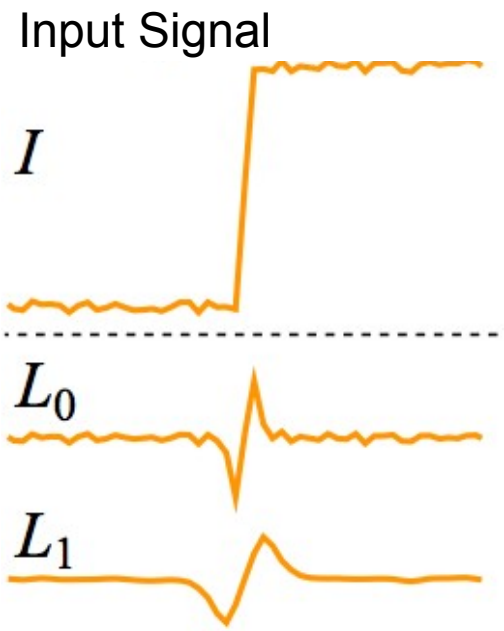
- Upsampling:



Ref[1]

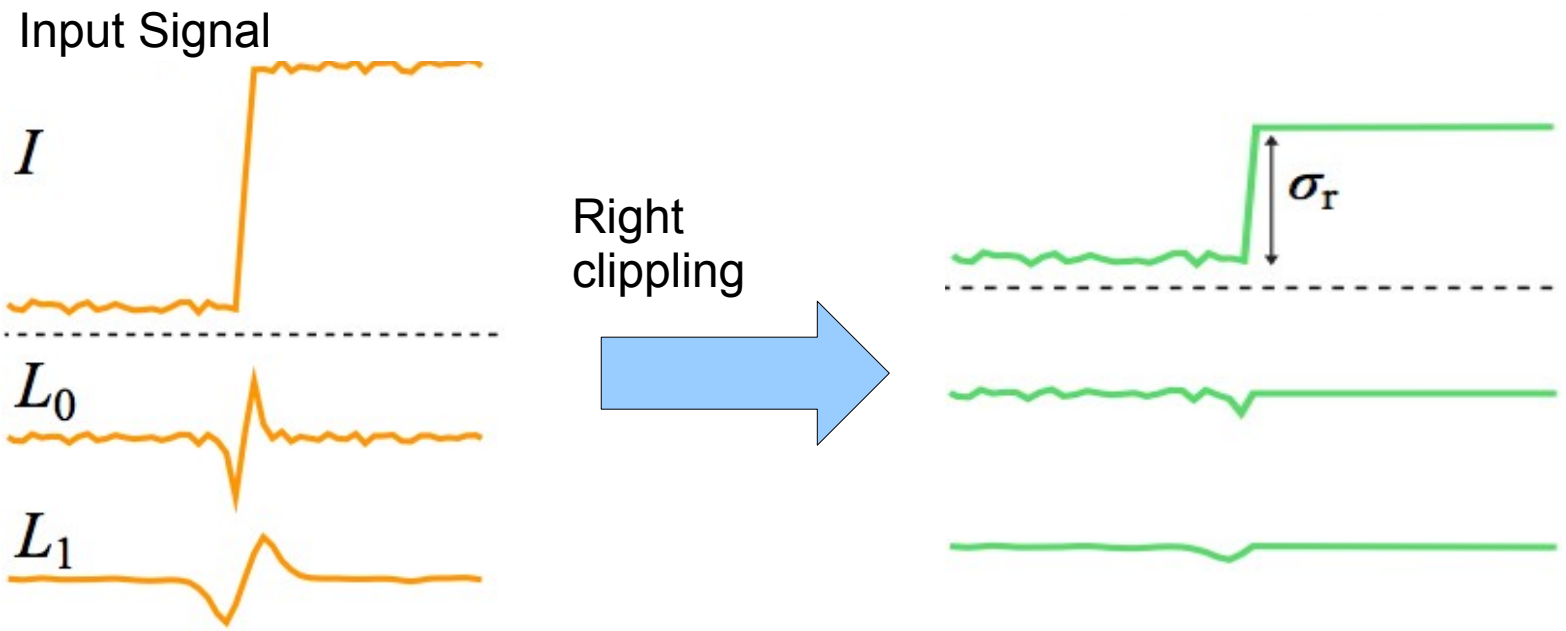
Local Laplacian Filtering

- Range compression and clipping



Local Laplacian Filtering

- Range compression and clipping



Local Laplacian Filtering

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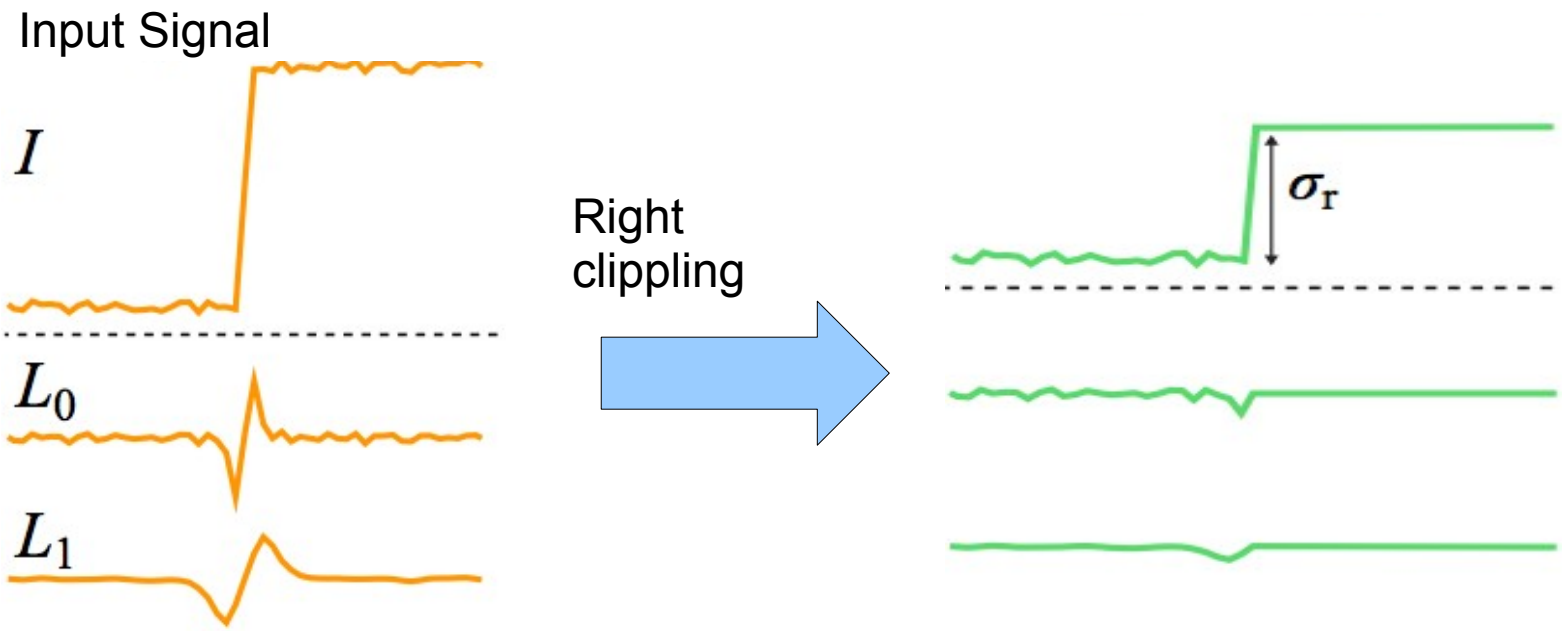

Local Laplacian Filtering

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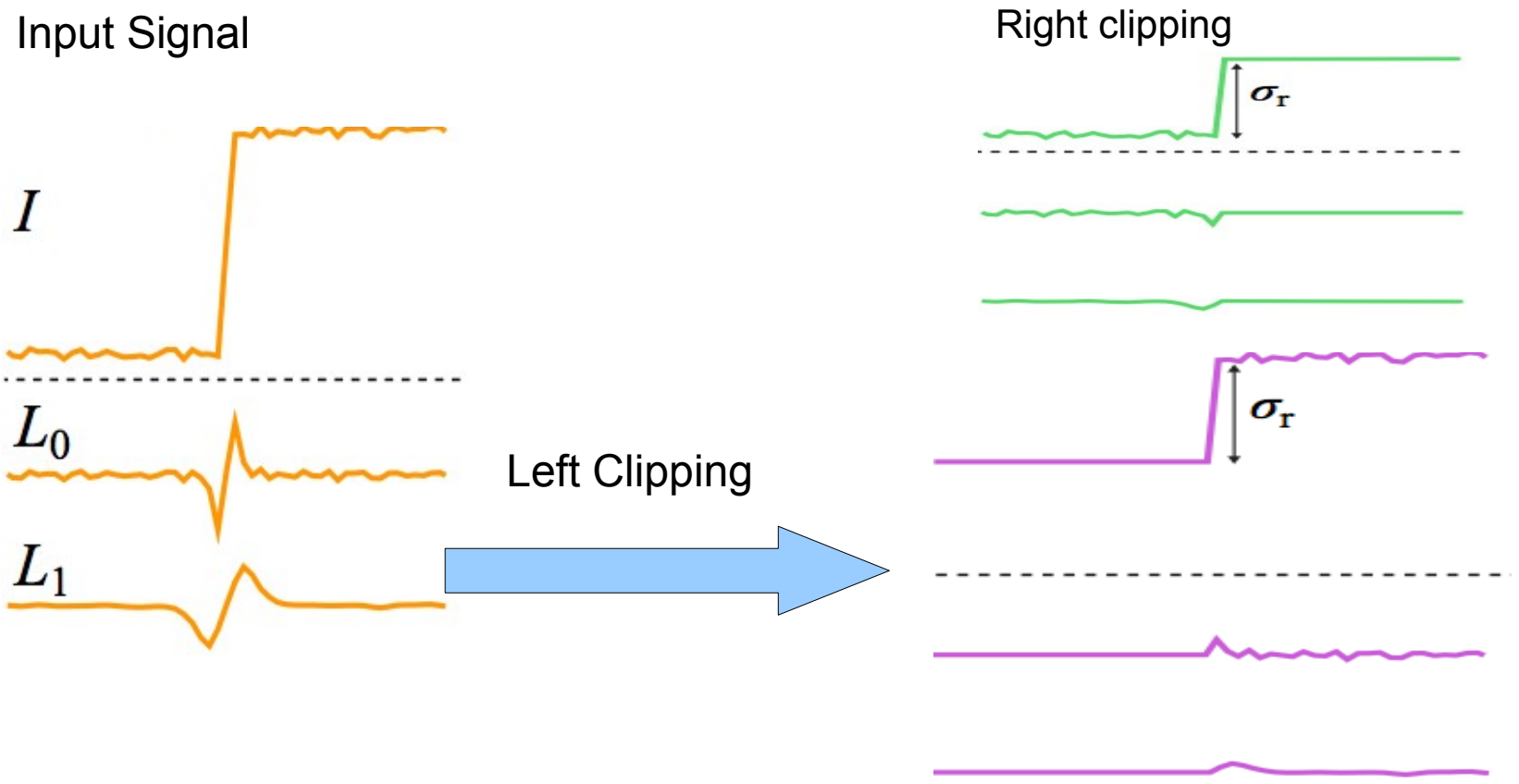

Local Laplacian Filtering

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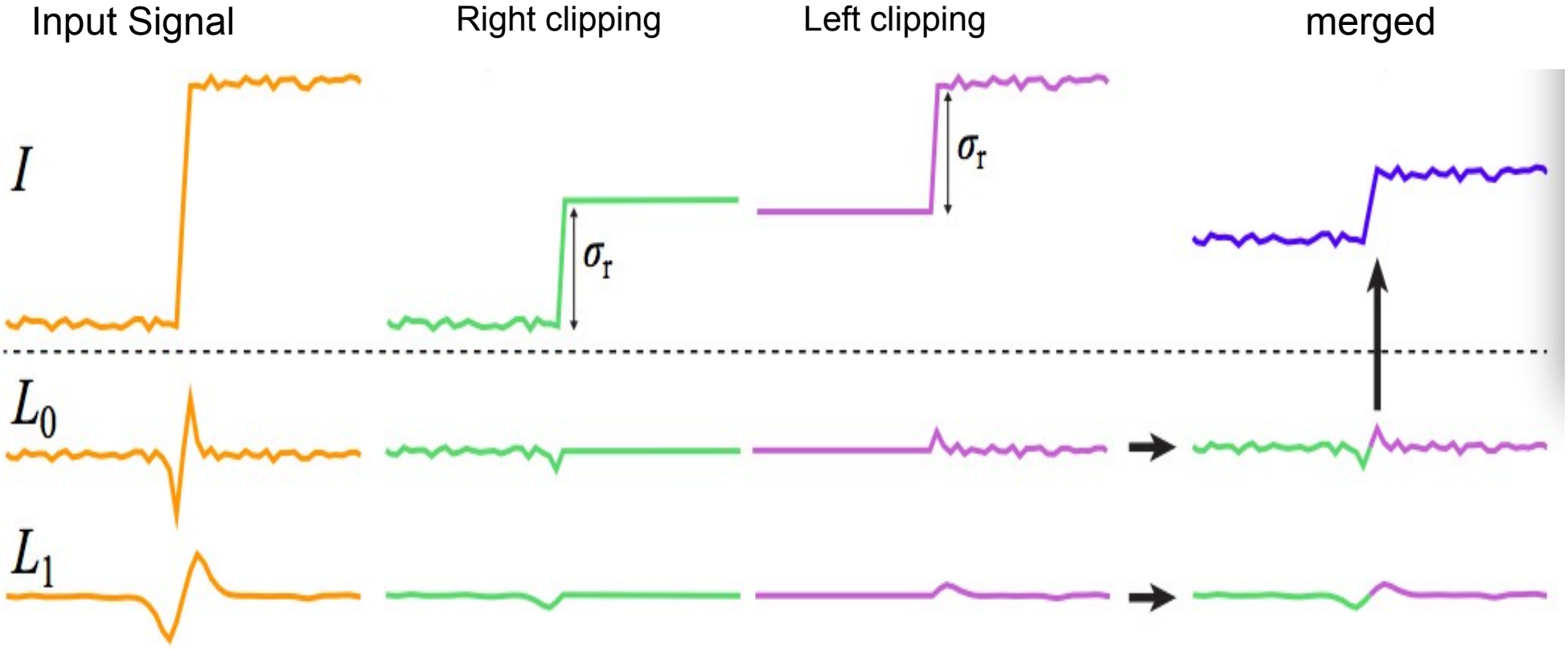
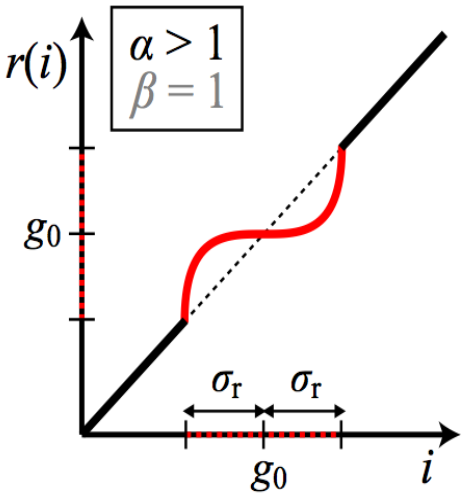


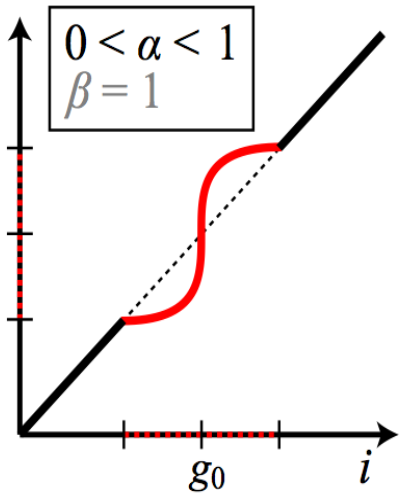
Point-wise Remapping function

edge--aware detail manipulation

detail smoothing

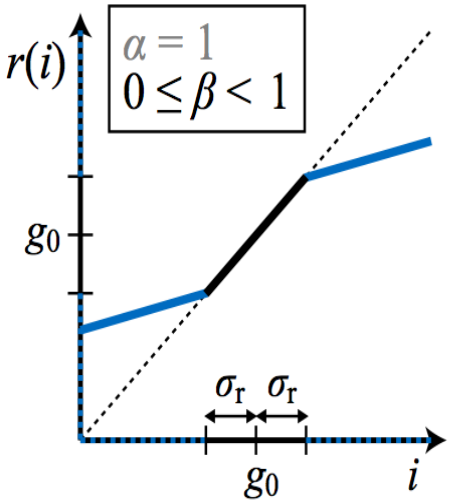


detail enhancement

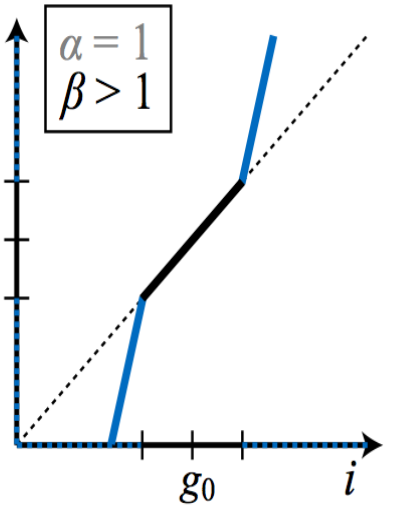


edge--aware tone manipulation

tone mapping

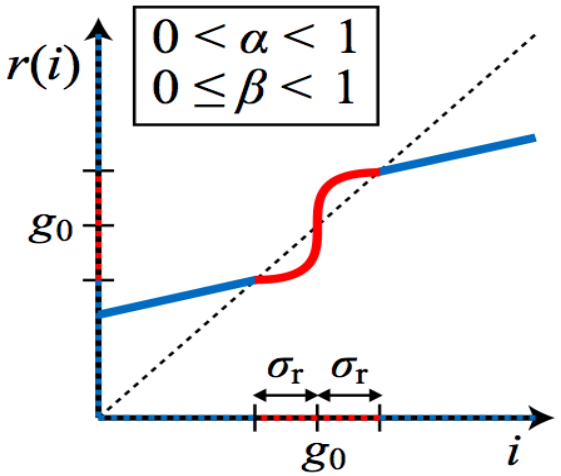


inverse tone mapping



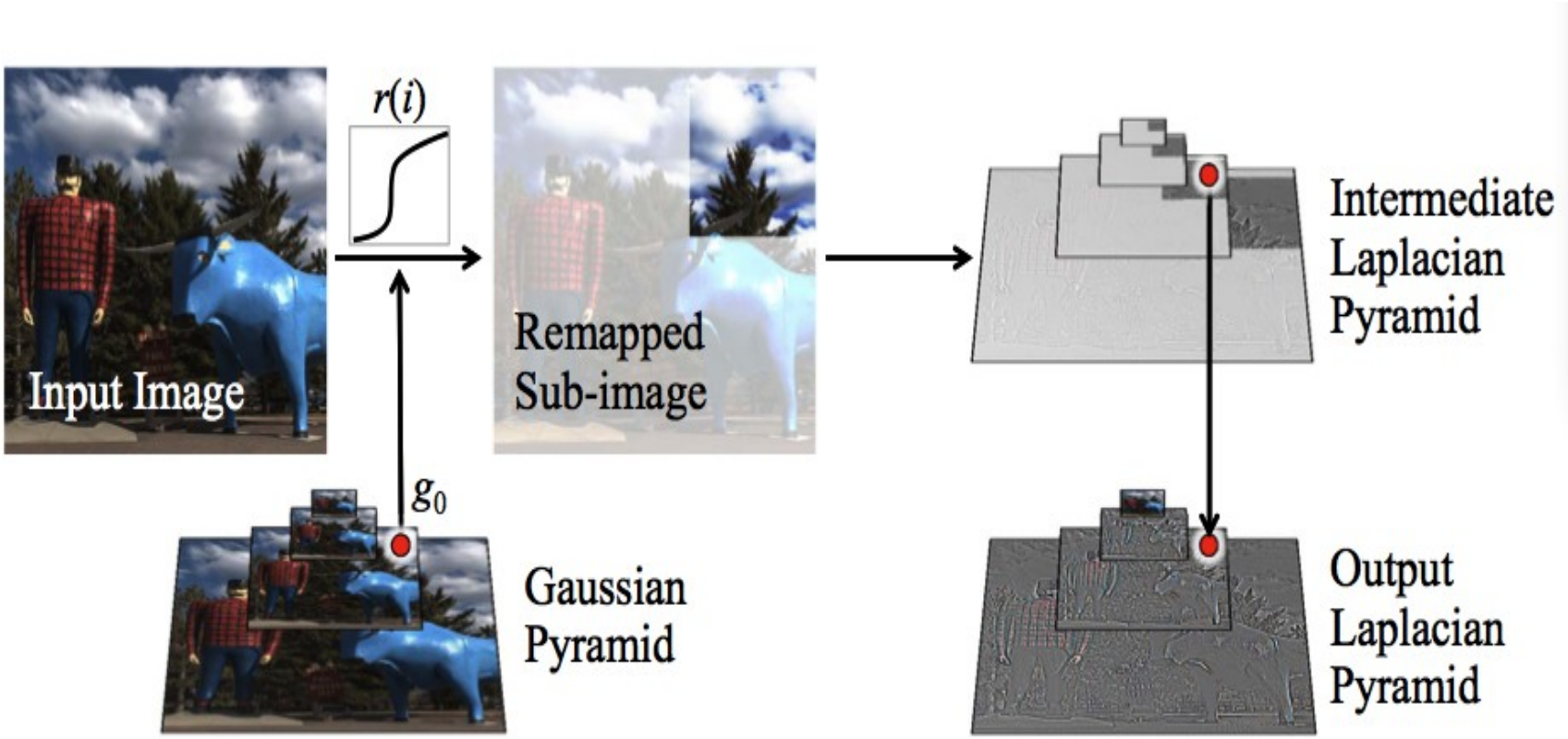
combined operator

detail enhance + tone map



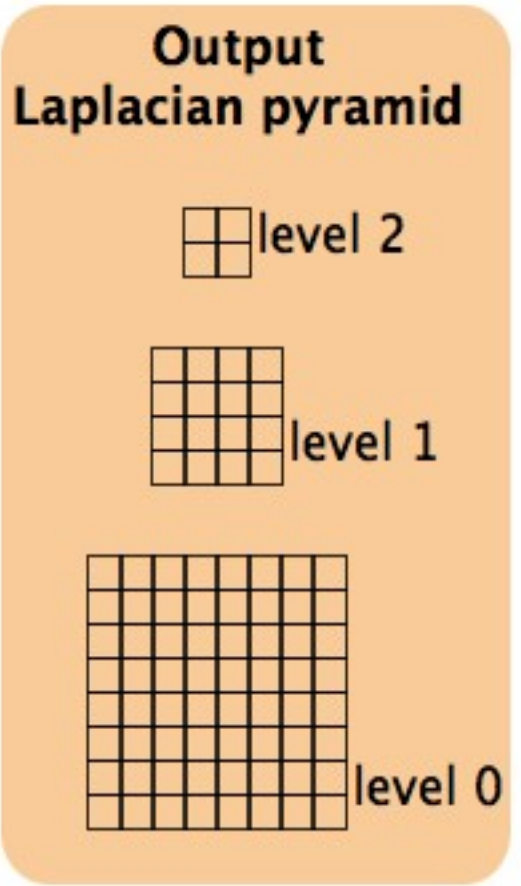
An overview of the algorithm

Approach: construct laplacian pyramid of filtered output

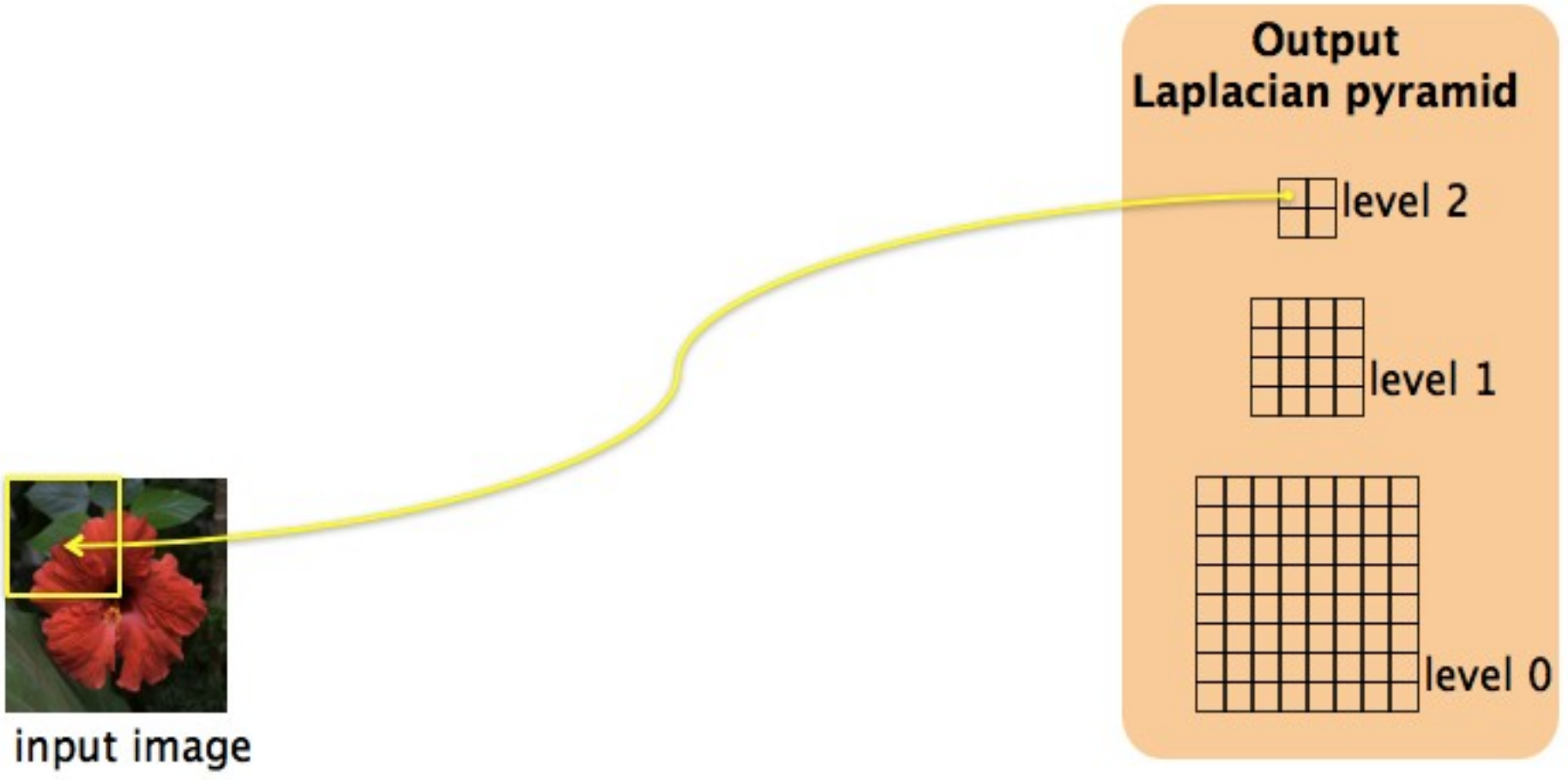


Illustration

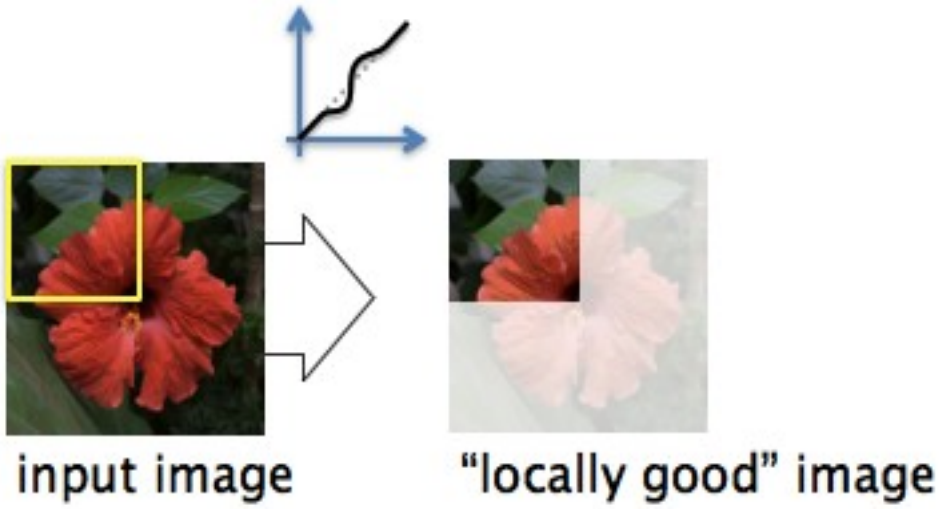
input image

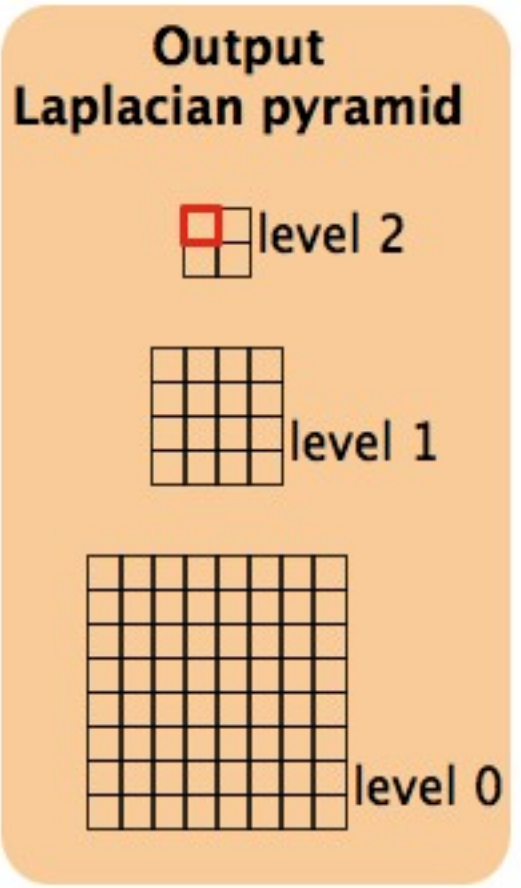


Illustration



Illustration





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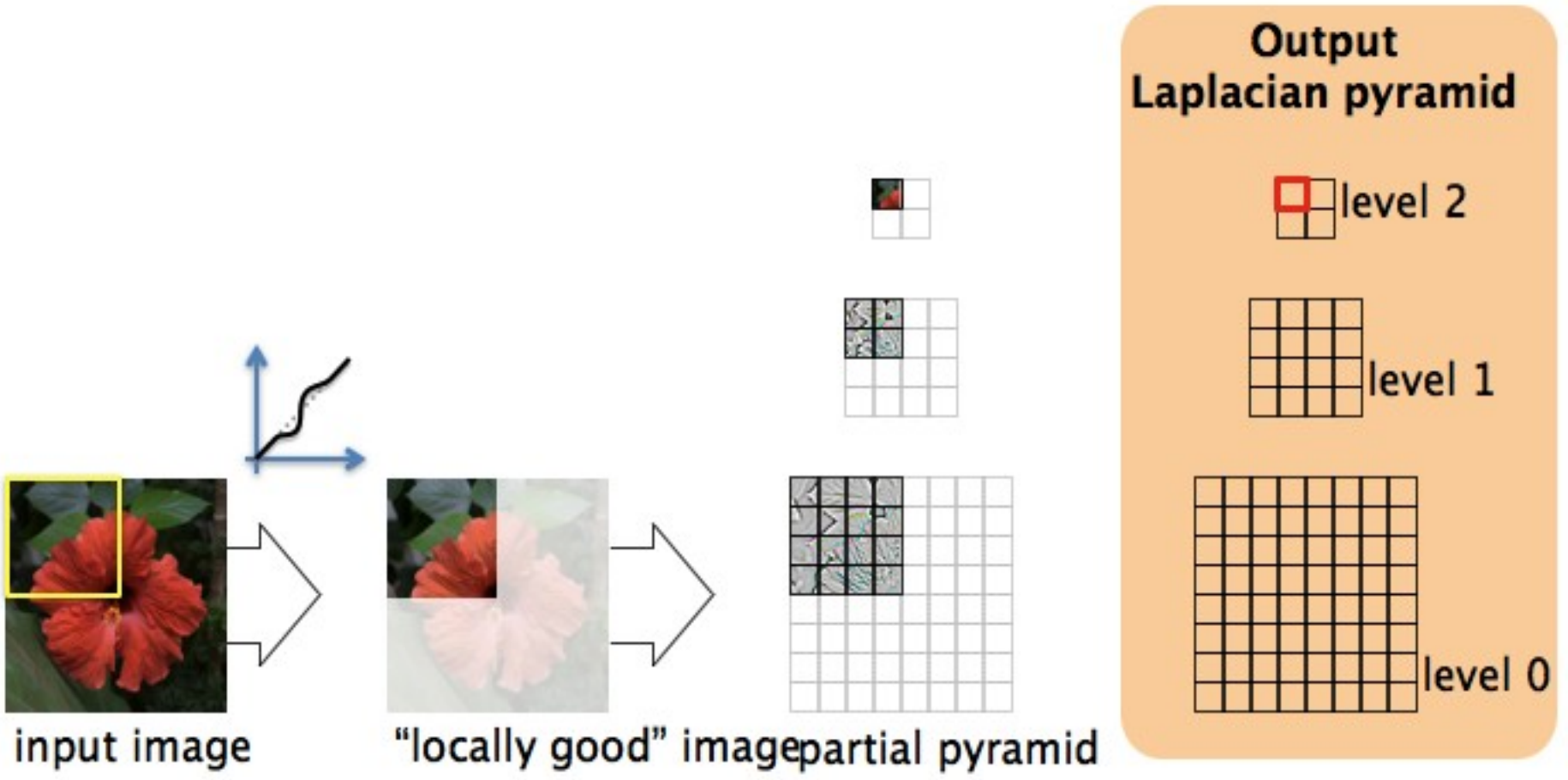

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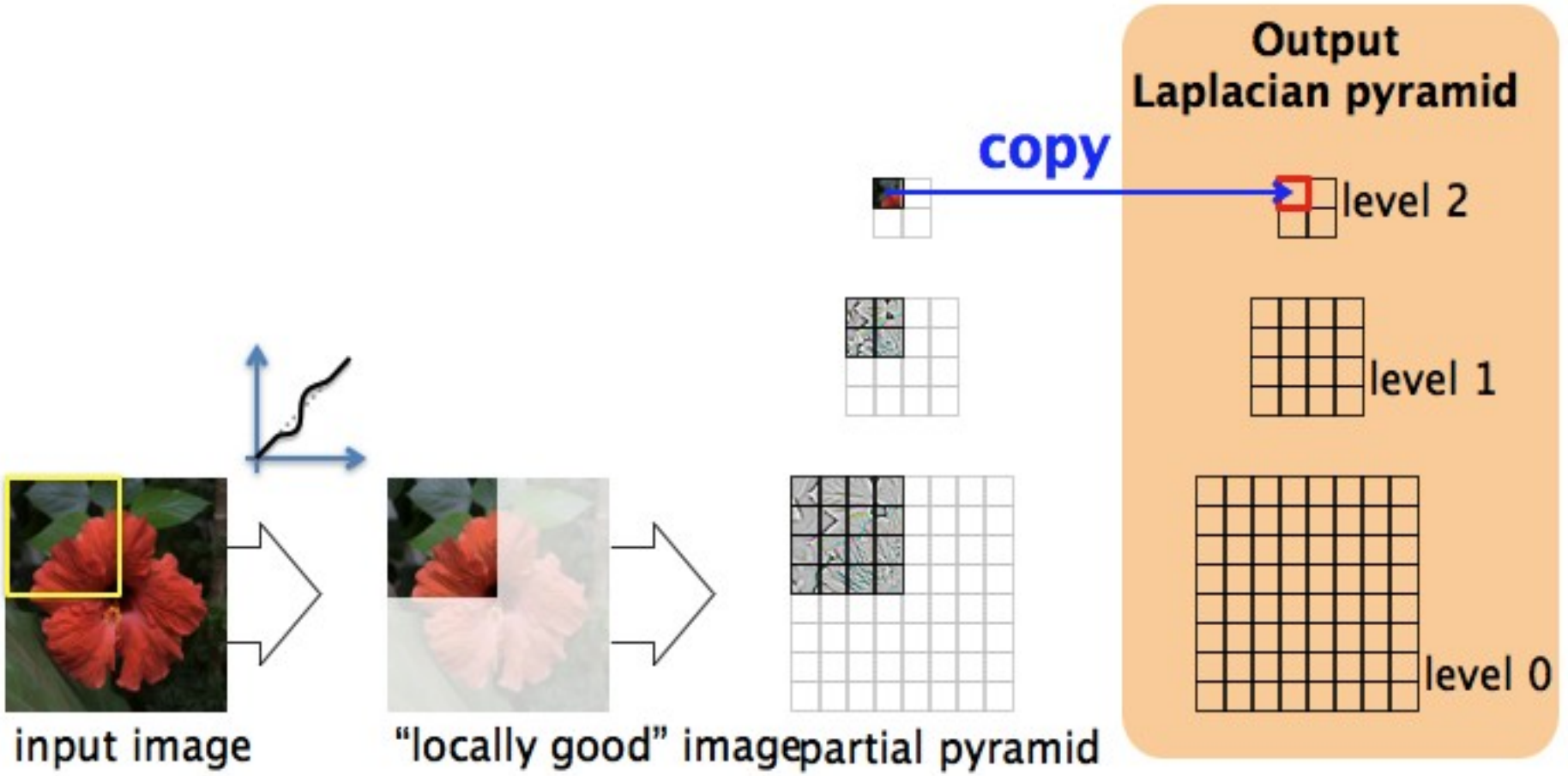

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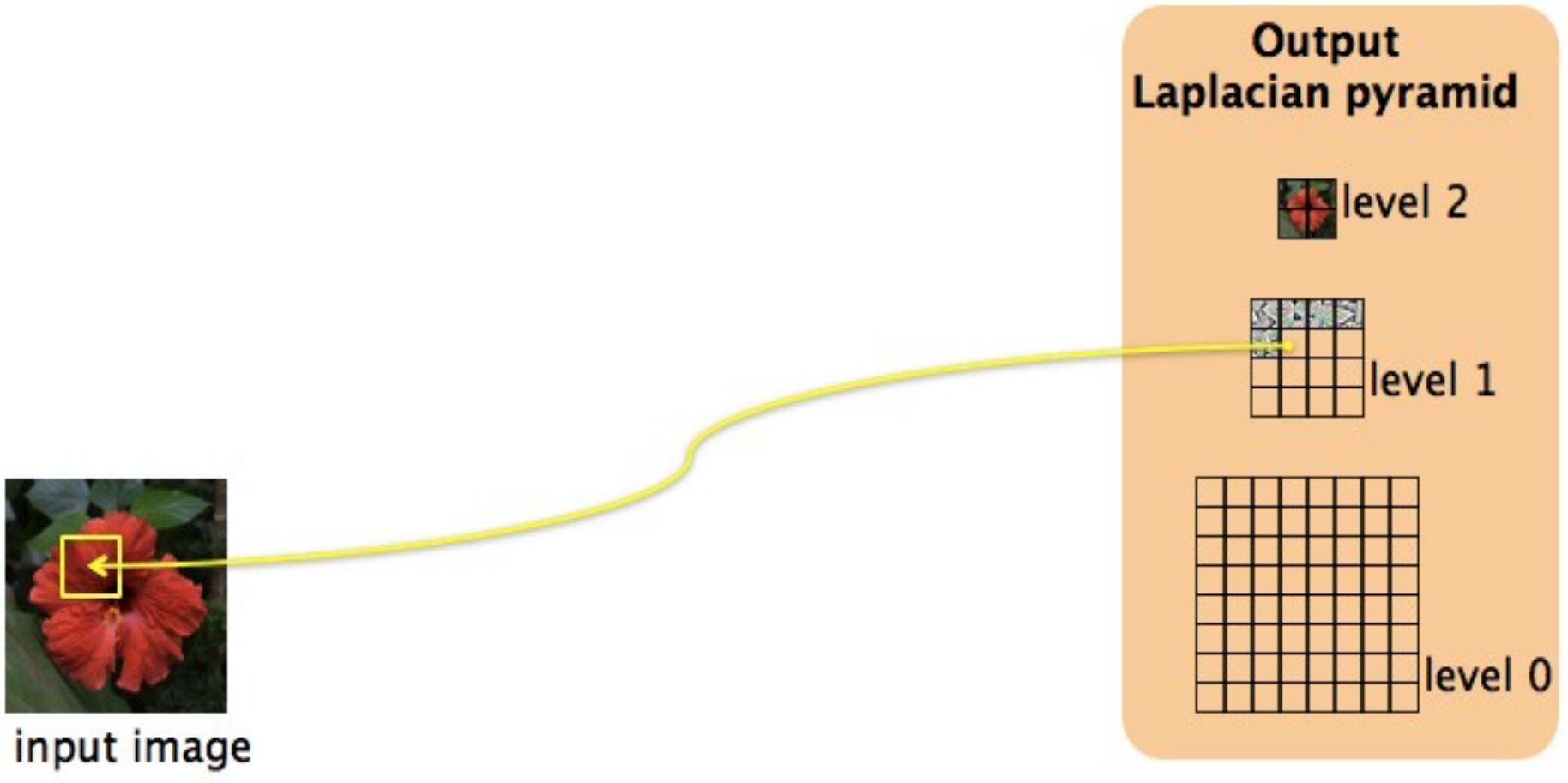

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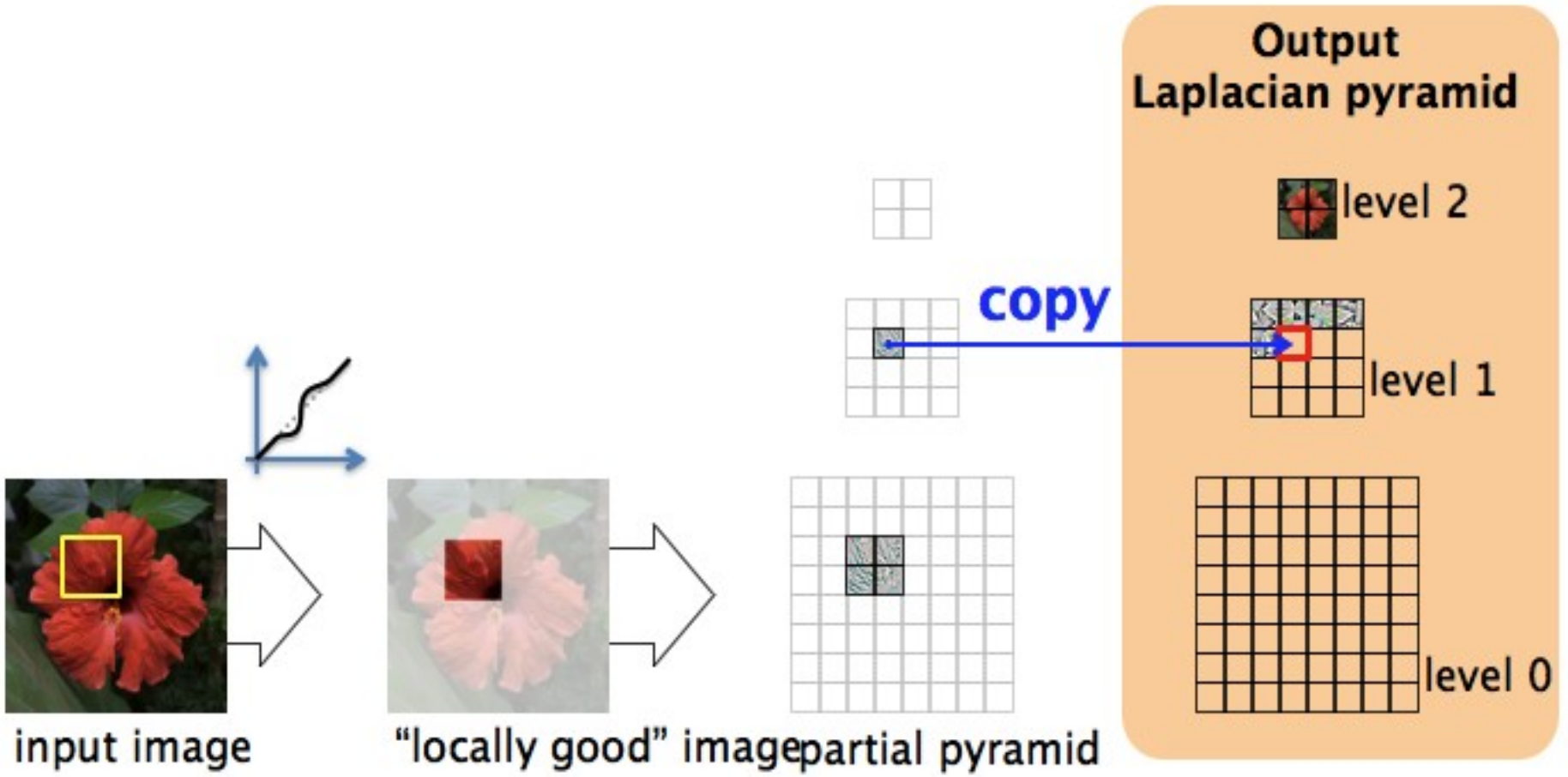


Application

- Detail manipulation
- Tone mapping

(a) $\sigma_r = 0.2$

(b) $\sigma_r = 0.5$

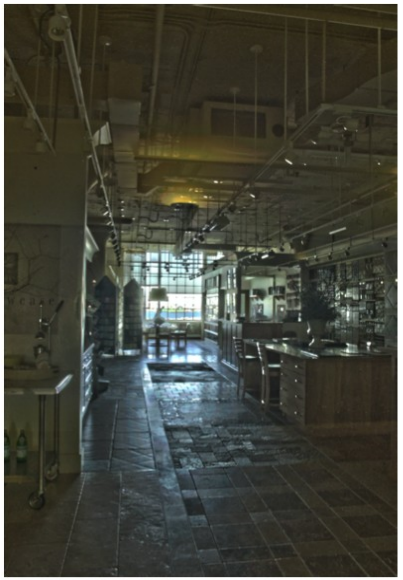
Application

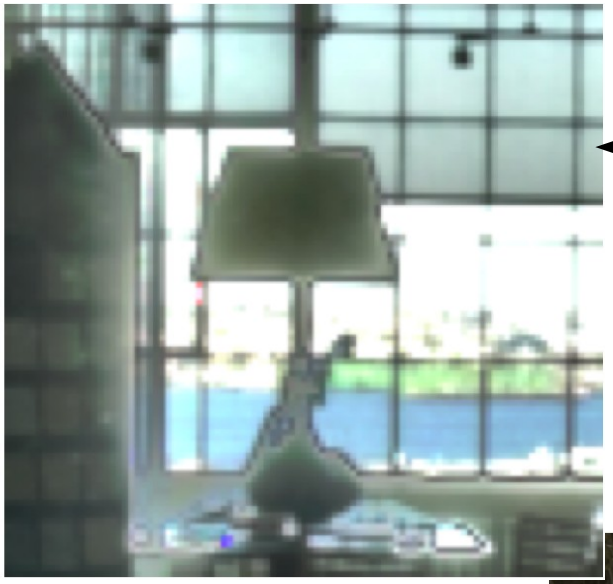
- Detail manipulation
- Tone mapping

(a) $\beta = 0$ $\sigma_r = \log(2.5)$ (b) $\beta = 0$ $\sigma_r = \log(30)$ (c) $\beta = 0.75$ $\sigma_r = \log(2.5)$

β, σ_r similar effects on tone mapping results α is set to 1

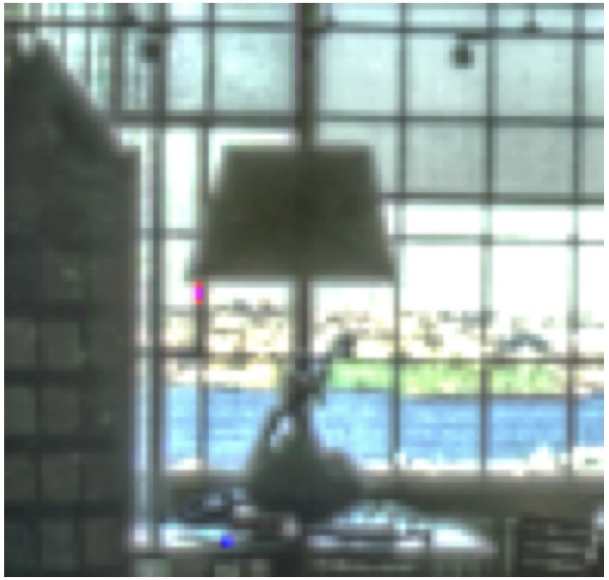
More Results





bilateral filter
and close up

Our result
and close up



More Results

Conclusion

- Edge aware
- Based solely on laplacian pyramid
- Simple method
- Robustness
- Artifact-free
- high quality image
- open new perspectives on multi-scale image analysis and editing

Reference

- Pyramid-based Image Synthesis Theory

  Shuguang Mao and Morgan Brown
- Advanced Image Analysis Christian Schmaltz
- Local Laplacian Filters: Edge-aware Image Processing with a Laplacian Pyramid

  Sylvain Paris, Samuel W. Hasinoff, Jan Kautz

Thank you