

Image/Mesh Filtering & Its Applications

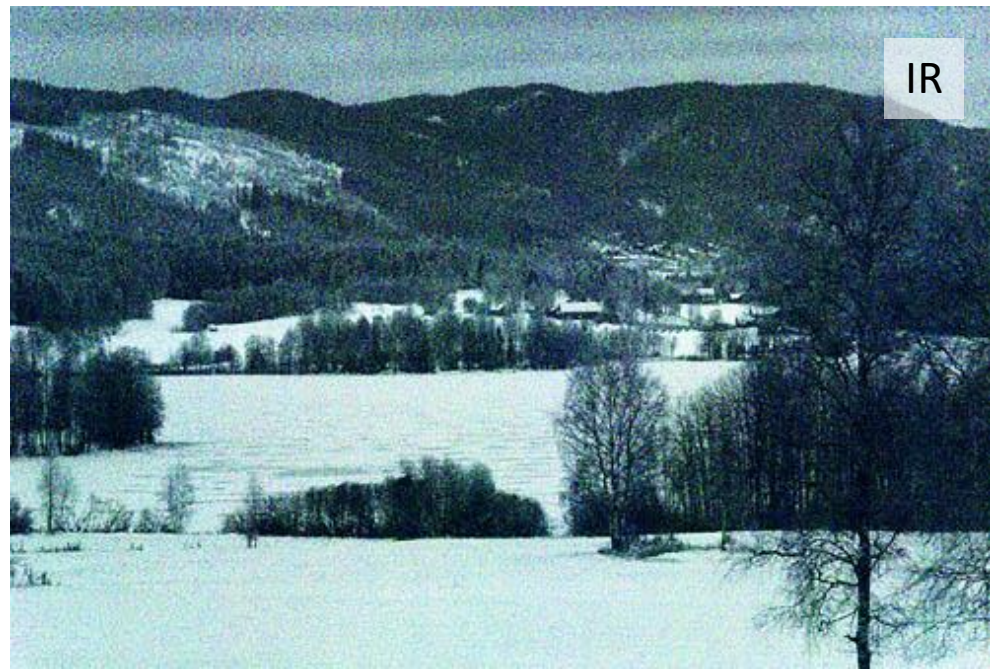
-- applications: denoising

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Indoor – low light



IR



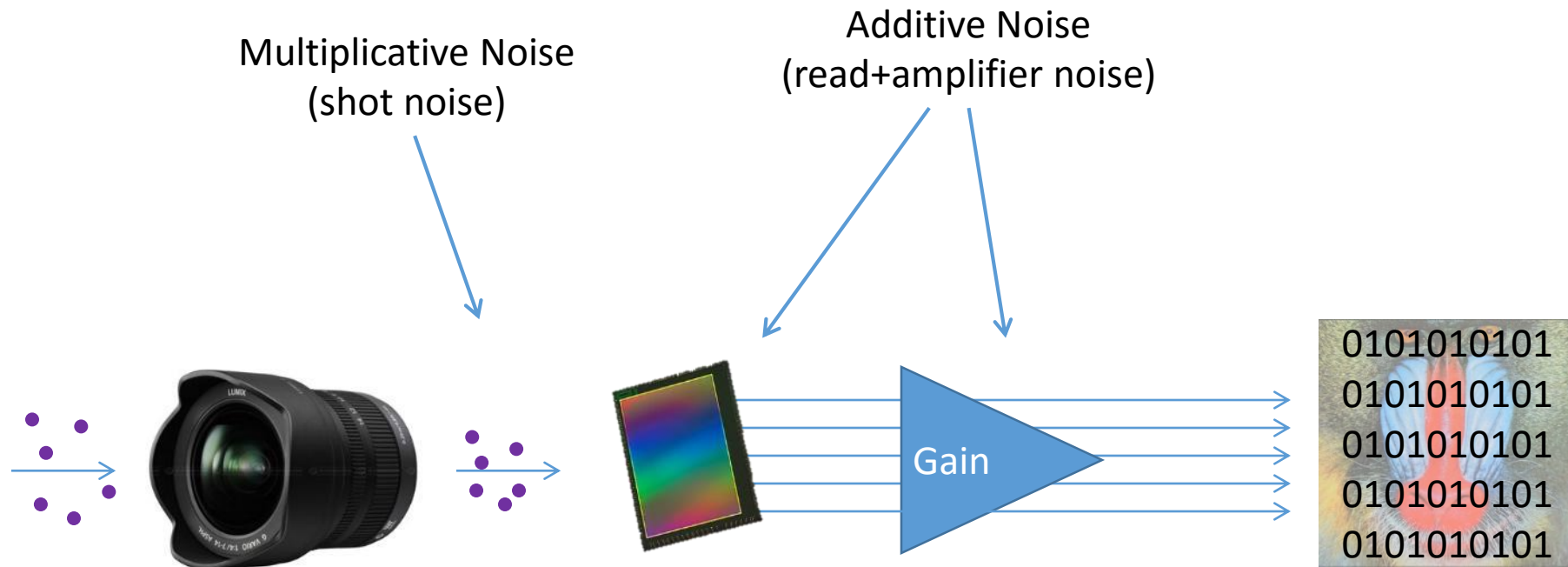
US



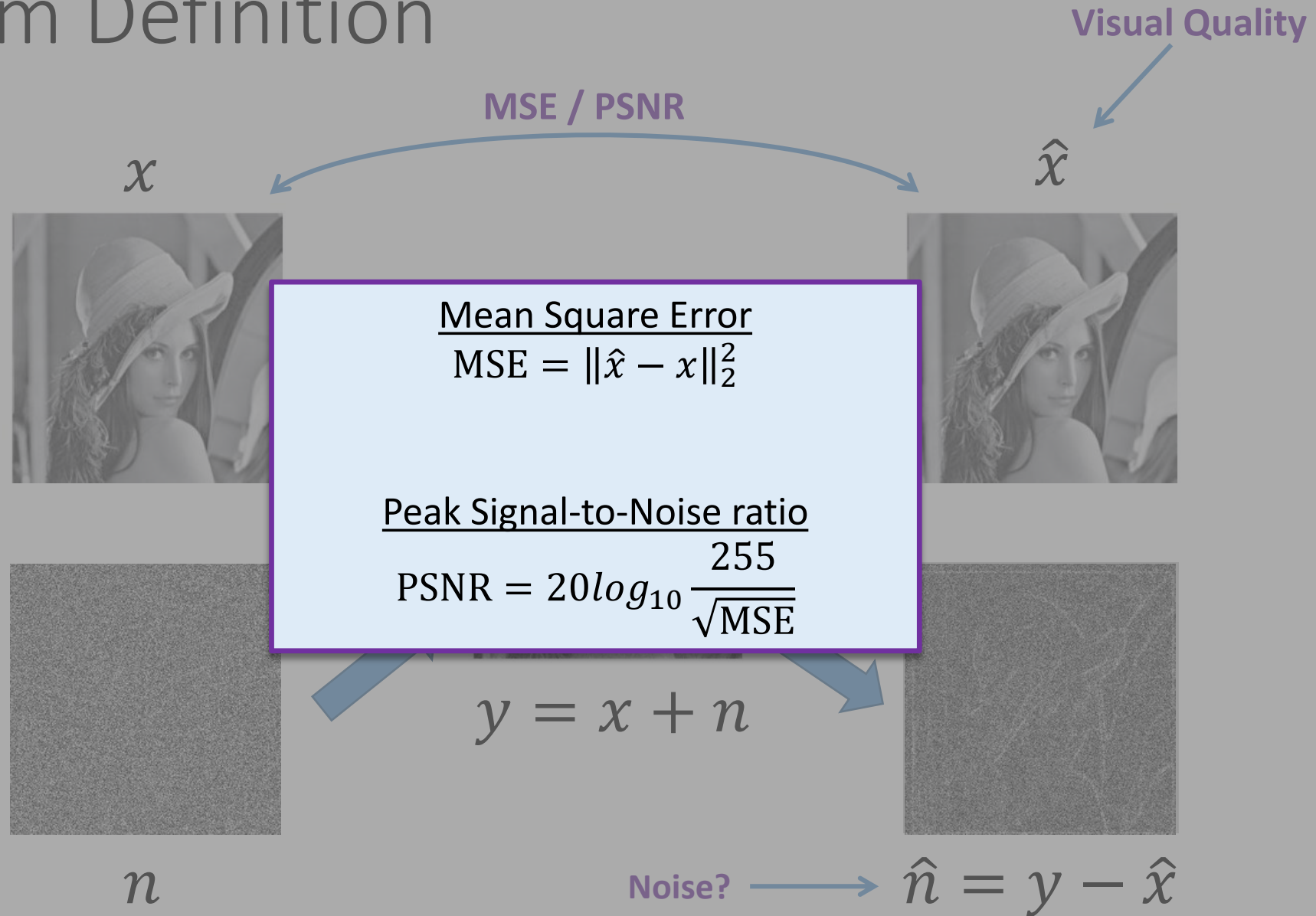
Can we (humans) denoise?



Sources of Noise



Problem Definition



Outline

- Classical Denoising
 - Spatial Methods
 - Transform Methods
- State-of-the-art Methods
 - GSM – Gaussian Scale Mixture
 - NLM – Non-local means
 - BM3D – Block Matching 3D collaborative filtering

Comments

- Average improvement from naive Gaussian filtering to NLM – 4-5 dB
- Average improvement of 1 dB over 4 years (from BLS-GSM(2003) to BM3D(2007))
- Saturation in PSNR over the last 4 years (BM3D still considered state of the art)

Overview

- **Denoising**

Not most powerful application
Not best denoising, but good & simple



- Tone mapping

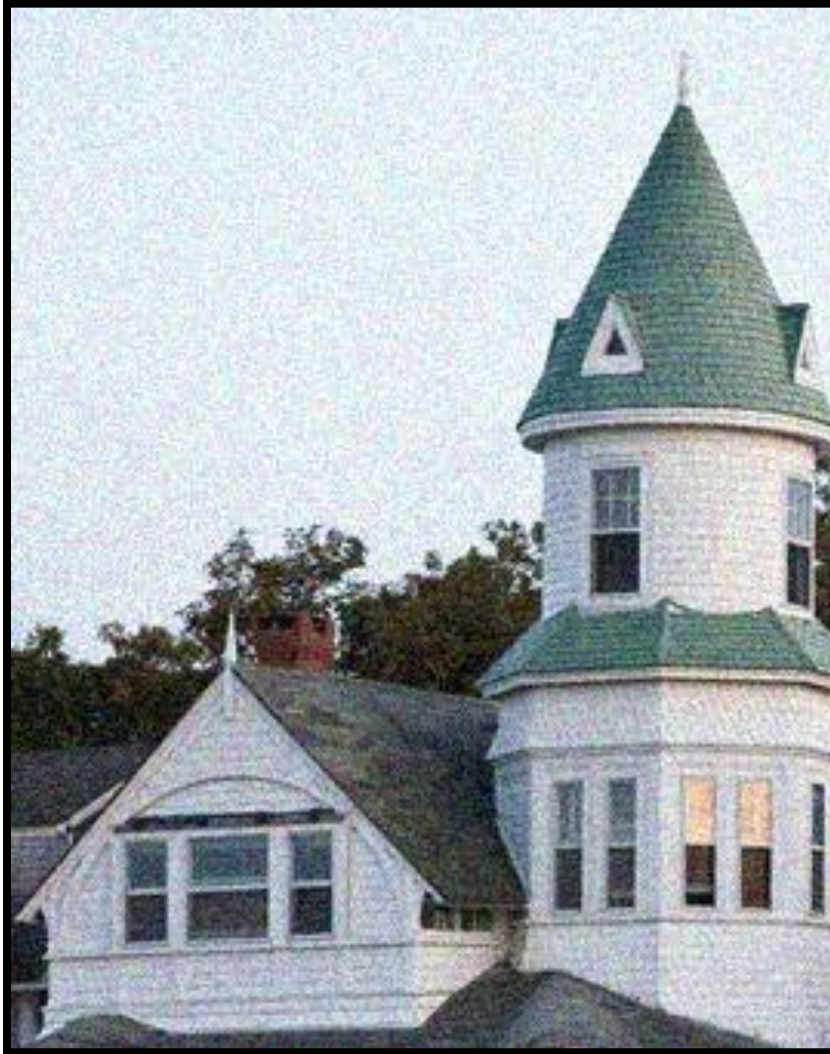


- Relighting & texture editing



Basic denoising

Noisy input

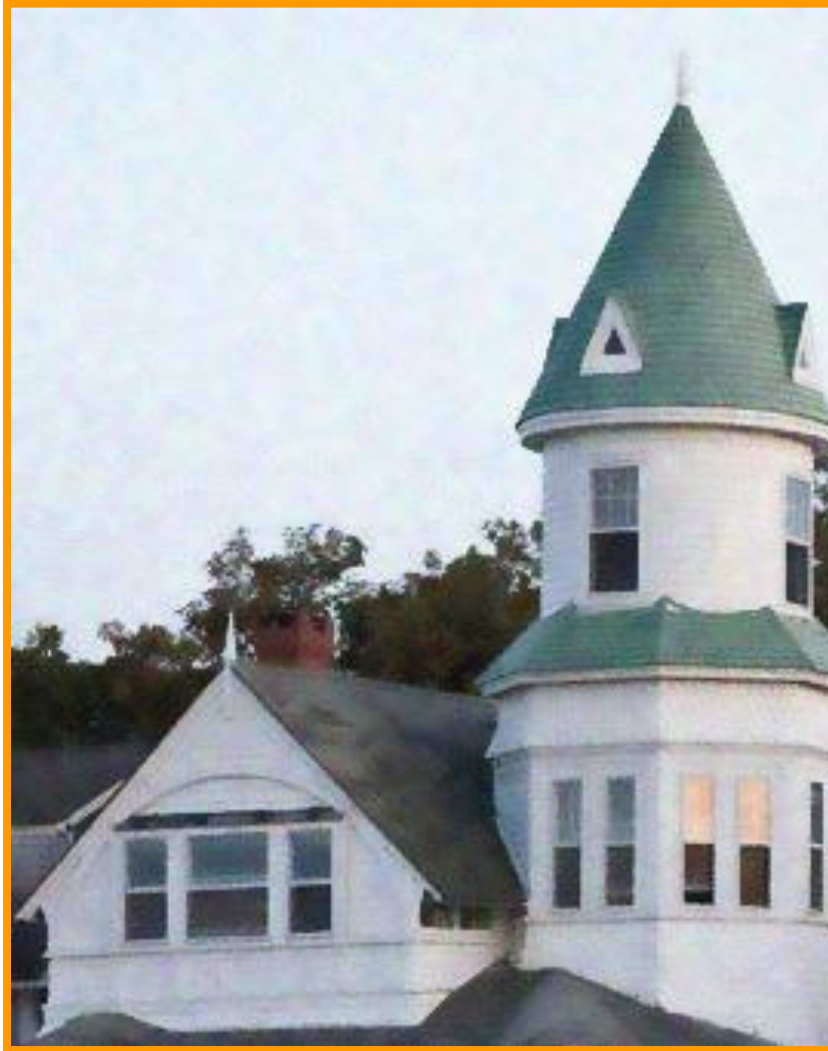


Bilateral filter 7x7 window



Basic denoising

Bilateral filter

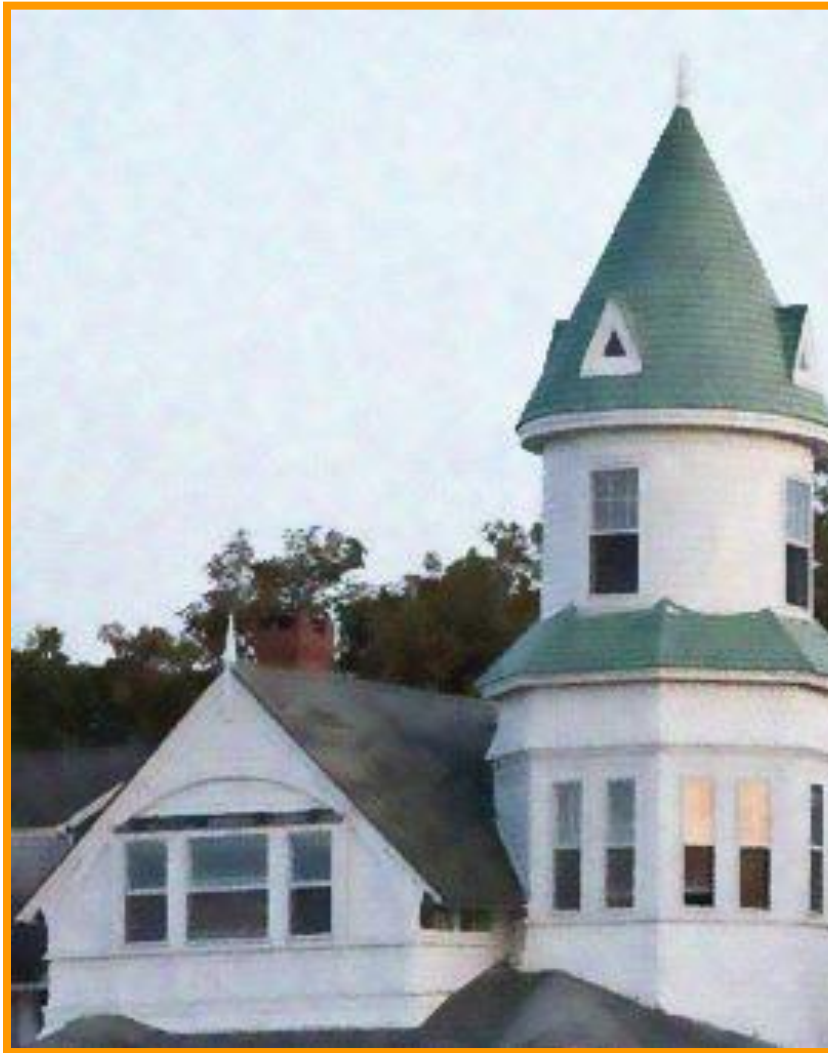


Median 3x3



Basic denoising

Bilateral filter

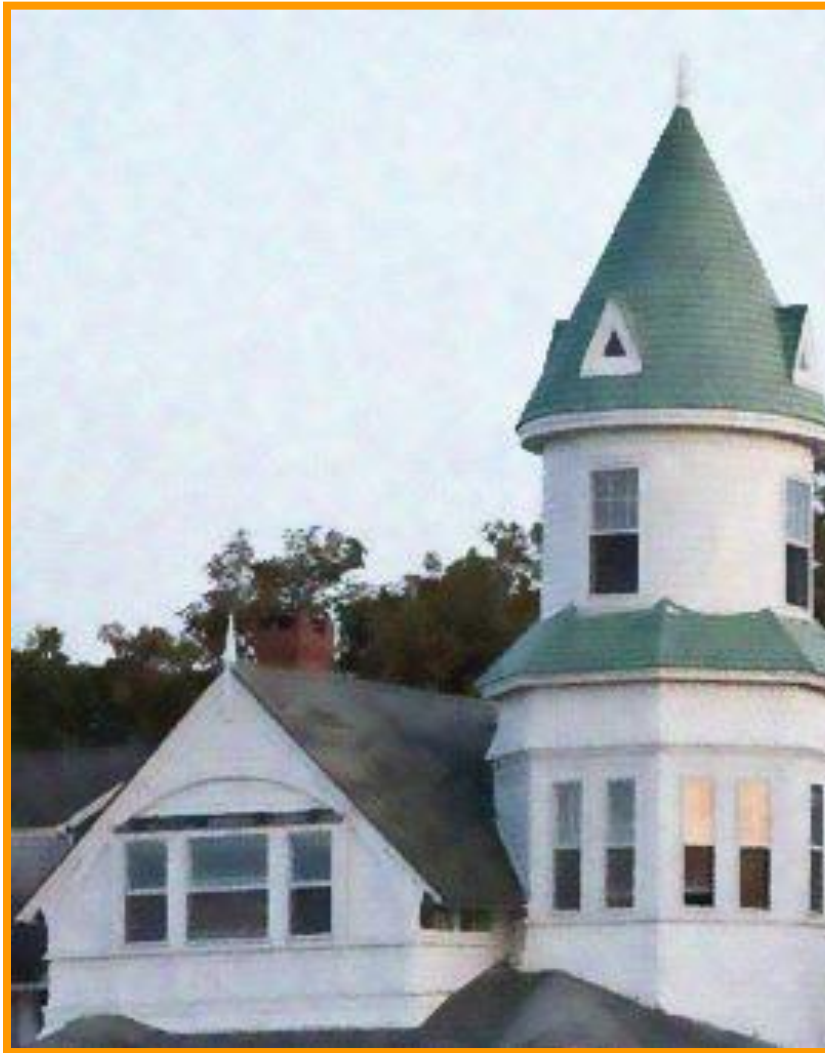


Median 5x5

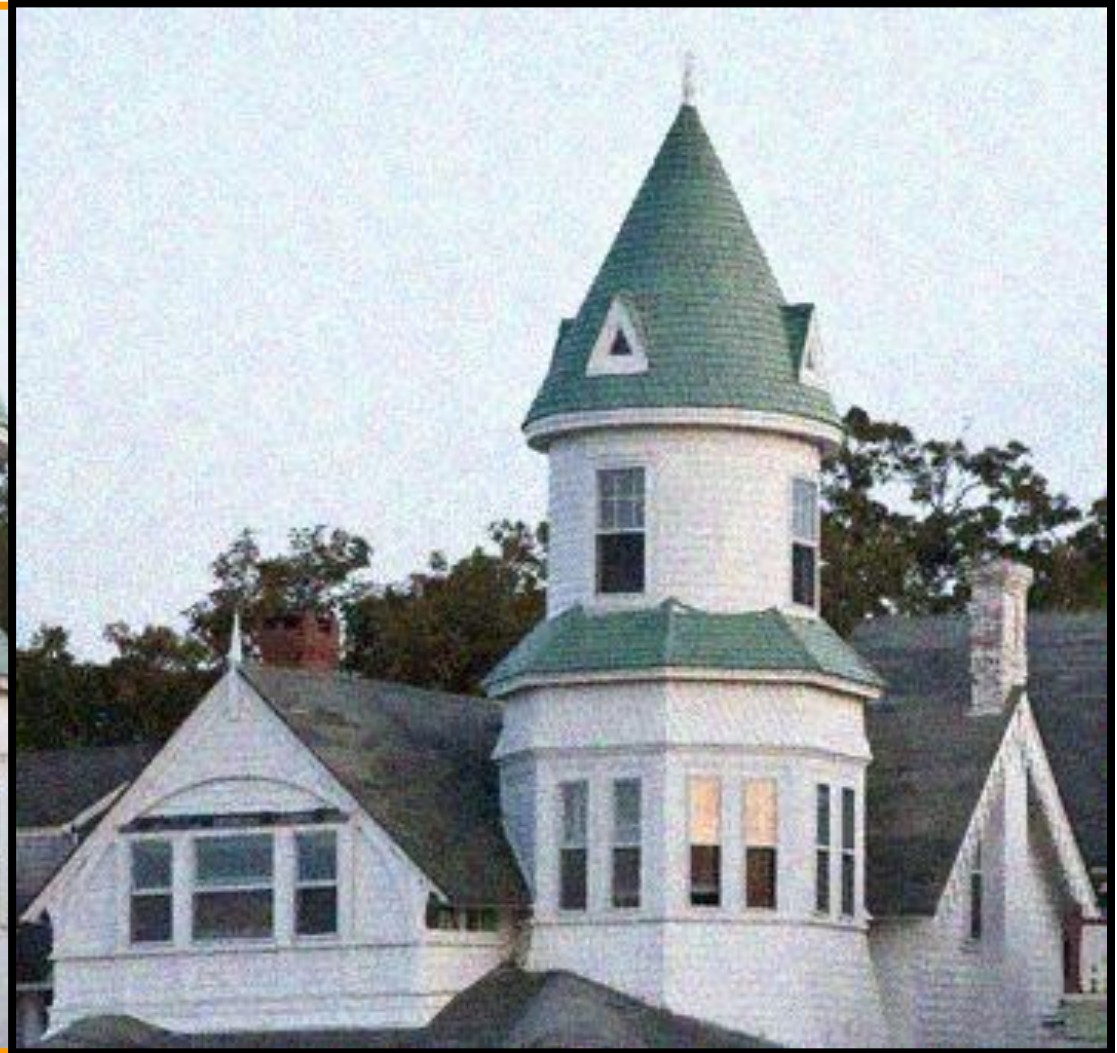


Basic denoising

Bilateral filter

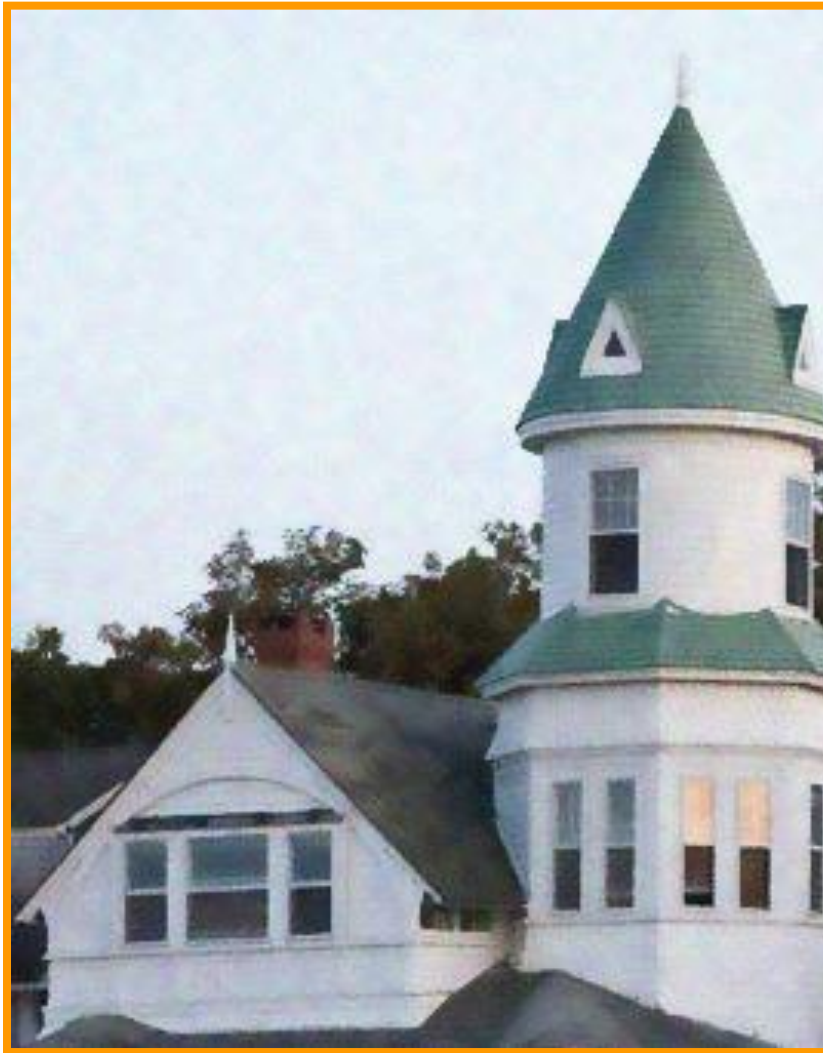


Bilateral filter – lower sigma



Basic denoising

Bilateral filter



Bilateral filter – higher sigma



Denoising

- Small spatial sigma (e.g. 7x7 window)
- Adapt range sigma to noise level
- Maybe not best denoising method, but best simplicity/quality tradeoff
 - No need for acceleration (small kernel)
 - But the denoising feature in e.g. Photoshop is better

