Image/Mesh Filtering & Its Applications

-- non-local means filtering

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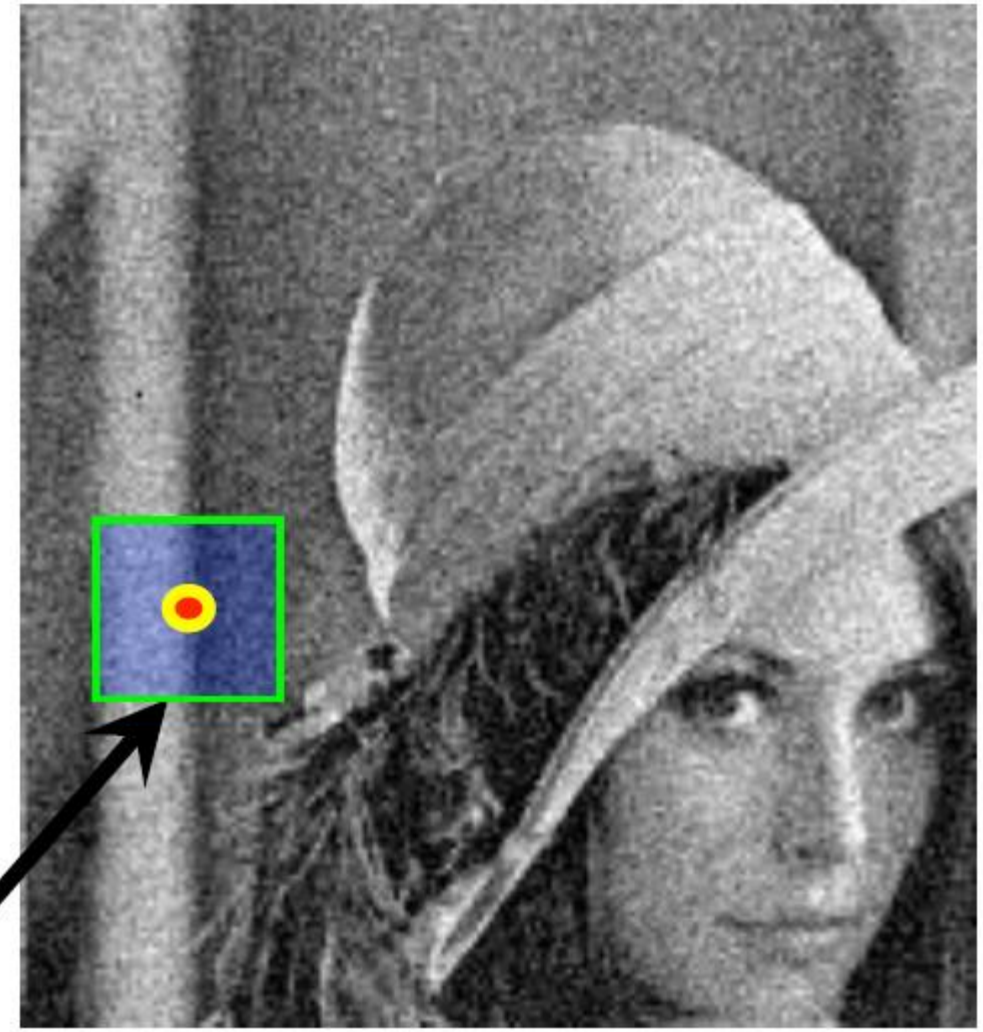
New Idea: NL-Means Filter (Buades 2005)

- Same goals: ‘Smooth within Similar Regions’
- **KEY INSIGHT**: Generalize, extend ‘Similarity’
  - **Bilateral:**
    - Averages local neighbors with **similar intensities**;
  - **NL-Means:**
    - Averages nonlocal neighbors with **similar neighborhoods!**

NL-Means Method: Buades (2005)

- For each and every pixel **p:**

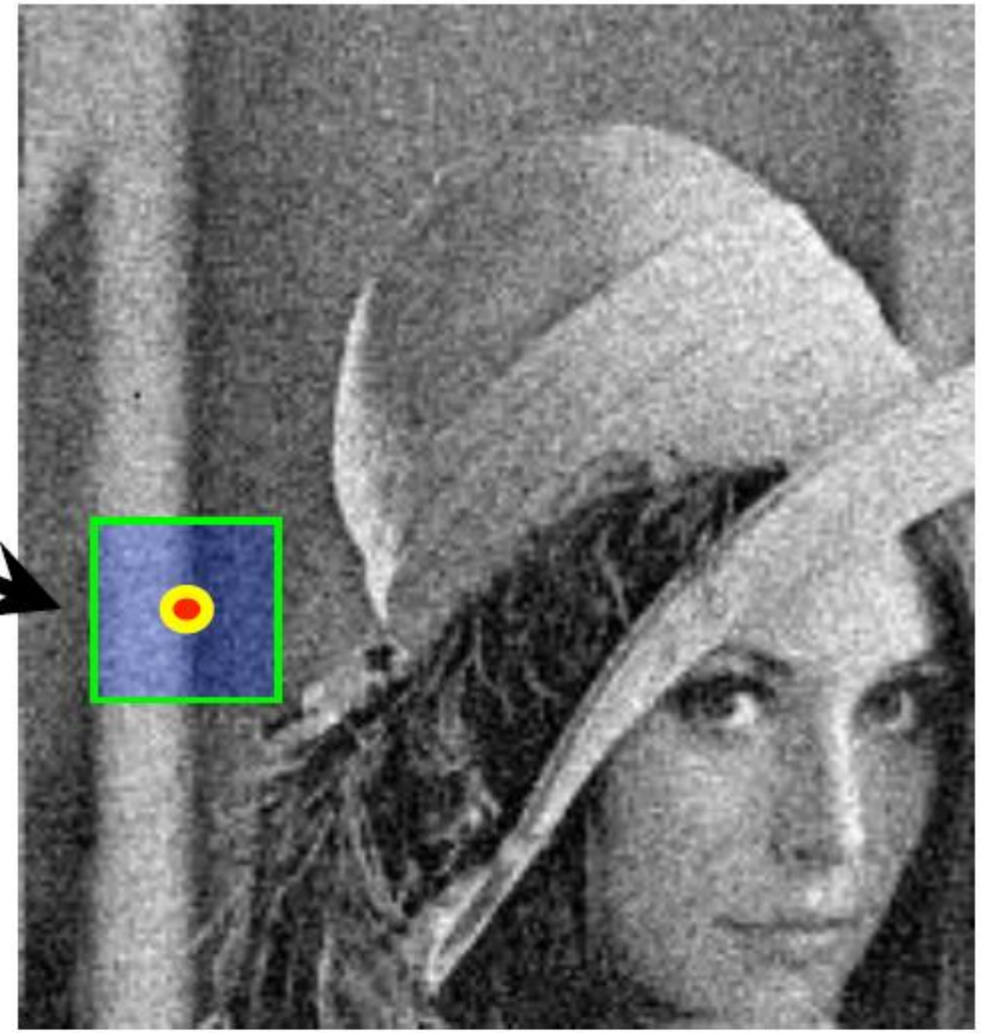
NL-Means Method: Buades (2005)



- For each and every pixel **p:**
  - Define a small, simple fixed size neighborhood;

NL-Means Method: Buades (2005)

$$V_p = \begin{bmatrix} 0.74 \\ 0.32 \\ 0.41 \\ 0.55 \\ \dots \\ \dots \\ \dots \end{bmatrix}$$



- For each and every pixel **p:**
  - Define a small, simple fixed size neighborhood;
  - Define vector $\mathbf{V_p}$: a list of neighboring pixel values.

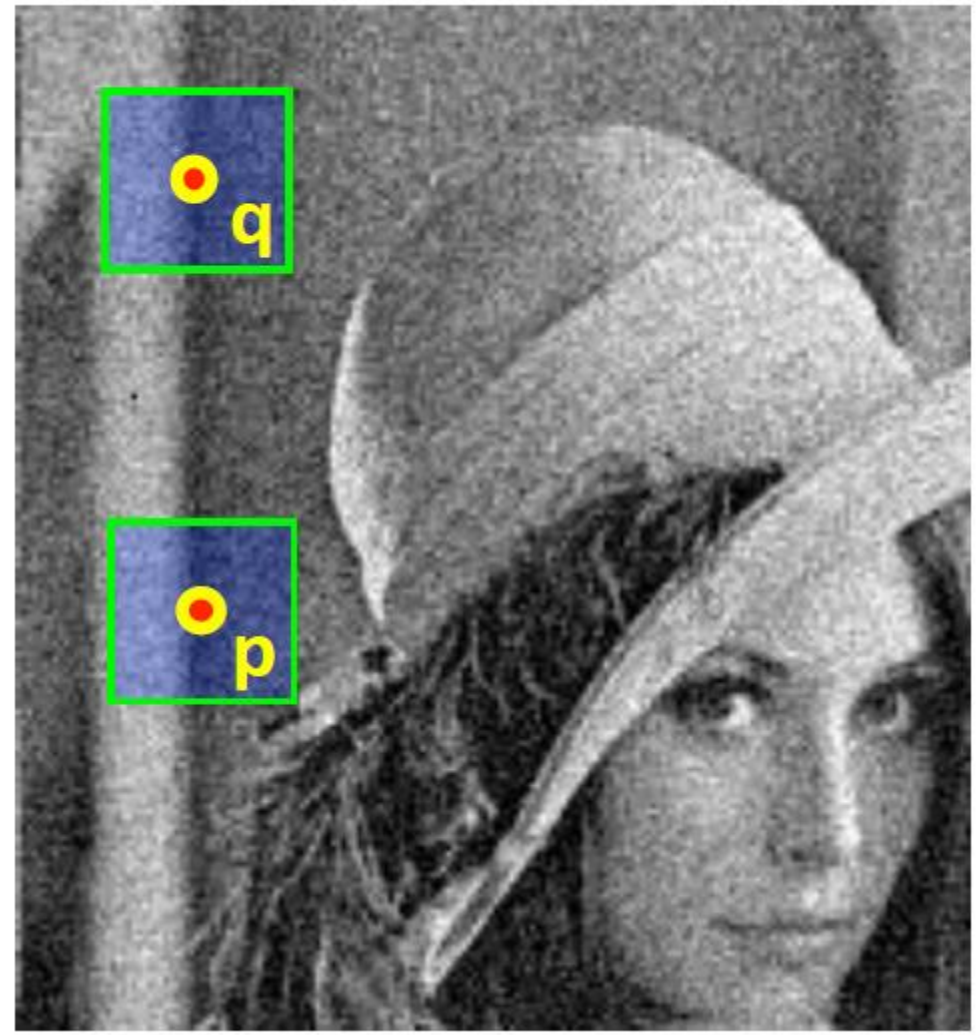
NL-Means Method: Buades (2005)

'Similar' pixels **p, q**

→ **SMALL**

vector distance;

$$|| V_p - V_q ||^2$$



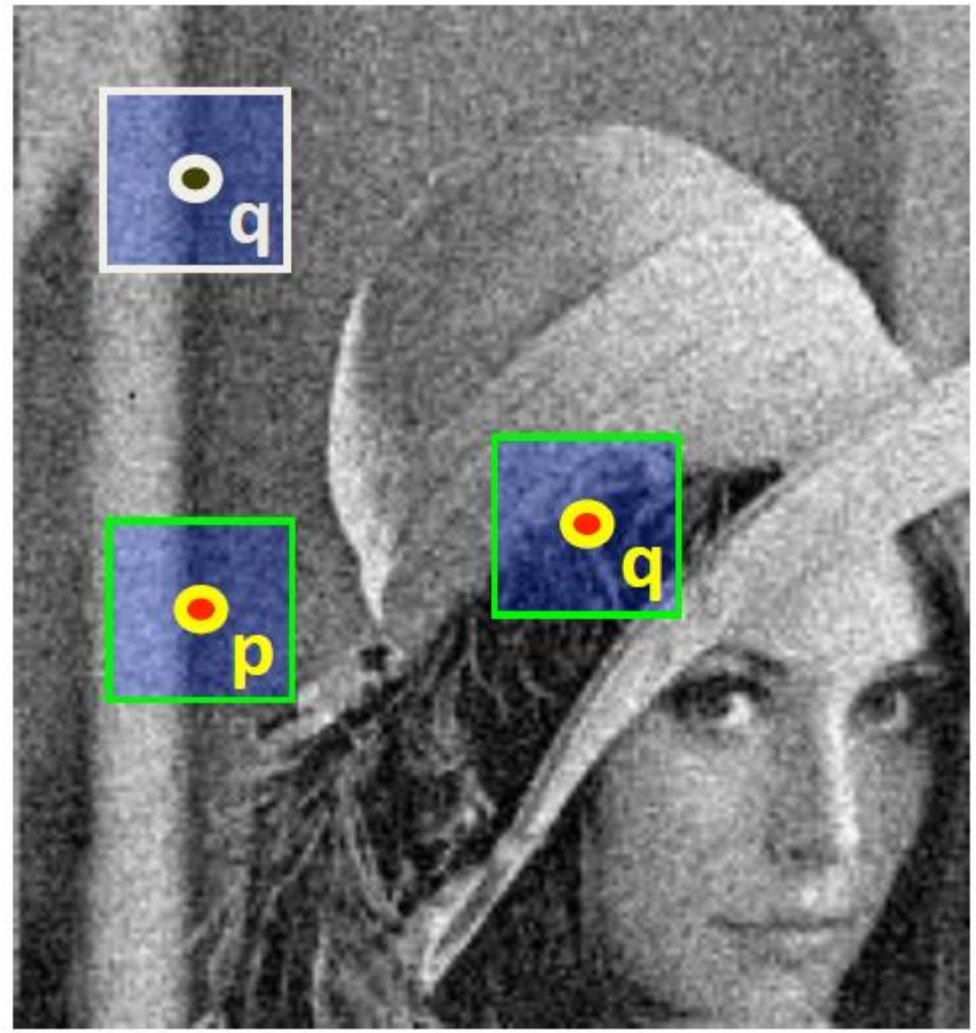
NL-Means Method: Buades (2005)

'Dissimilar' pixels **p, q**

→ **LARGE**

vector distance;

$$|| V_p - V_q ||^2$$



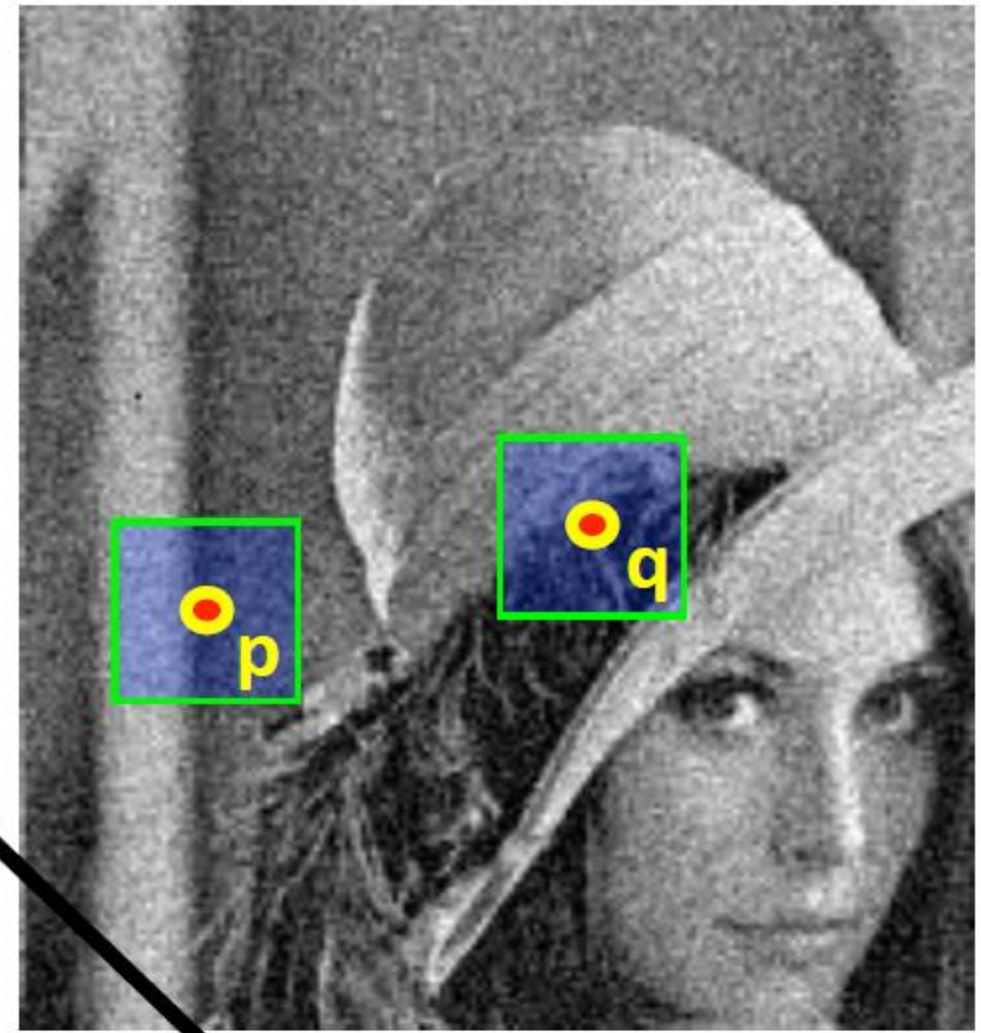
NL-Means Method: Buades (2005)

p, q neighbors define a vector distance;

$$|| V_p - V_q ||^2$$

Filter with this:

No spatial term!



$$NLMF[I]_{\mathbf{p}} = \frac{1}{W_{\mathbf{p}}} \sum_{\mathbf{q} \in S} G_{\sigma_s}(||\mathbf{p}-\mathbf{q}||) G_{\sigma_r}(||\vec{V}_{\mathbf{p}} - \vec{V}_{\mathbf{q}}||^2) I_{\mathbf{q}}$$

- Input, Gaussian, Anisotropic Diffusion, Biliteral, NLM

Advanced introduction