NR-Noise Reduce（基础篇上）

均值滤波、高斯滤波、双边滤波、NLM

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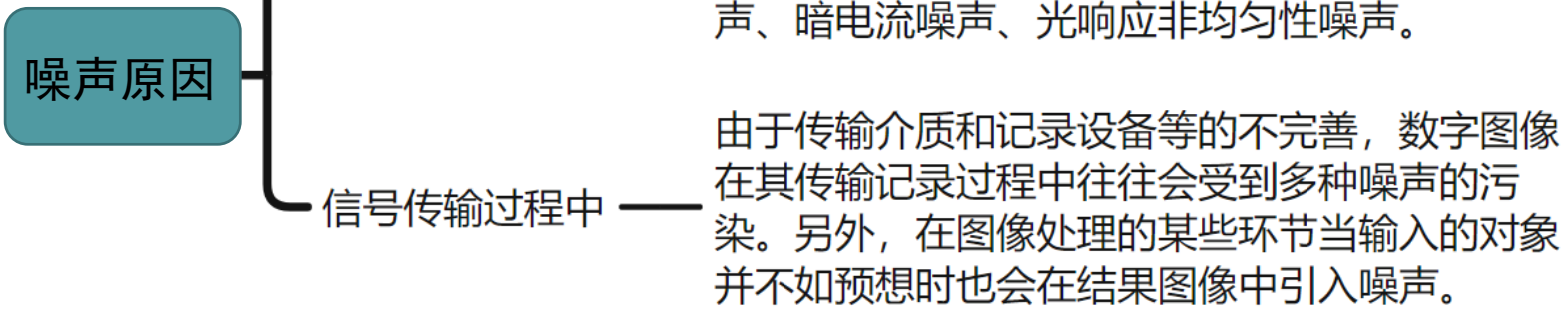
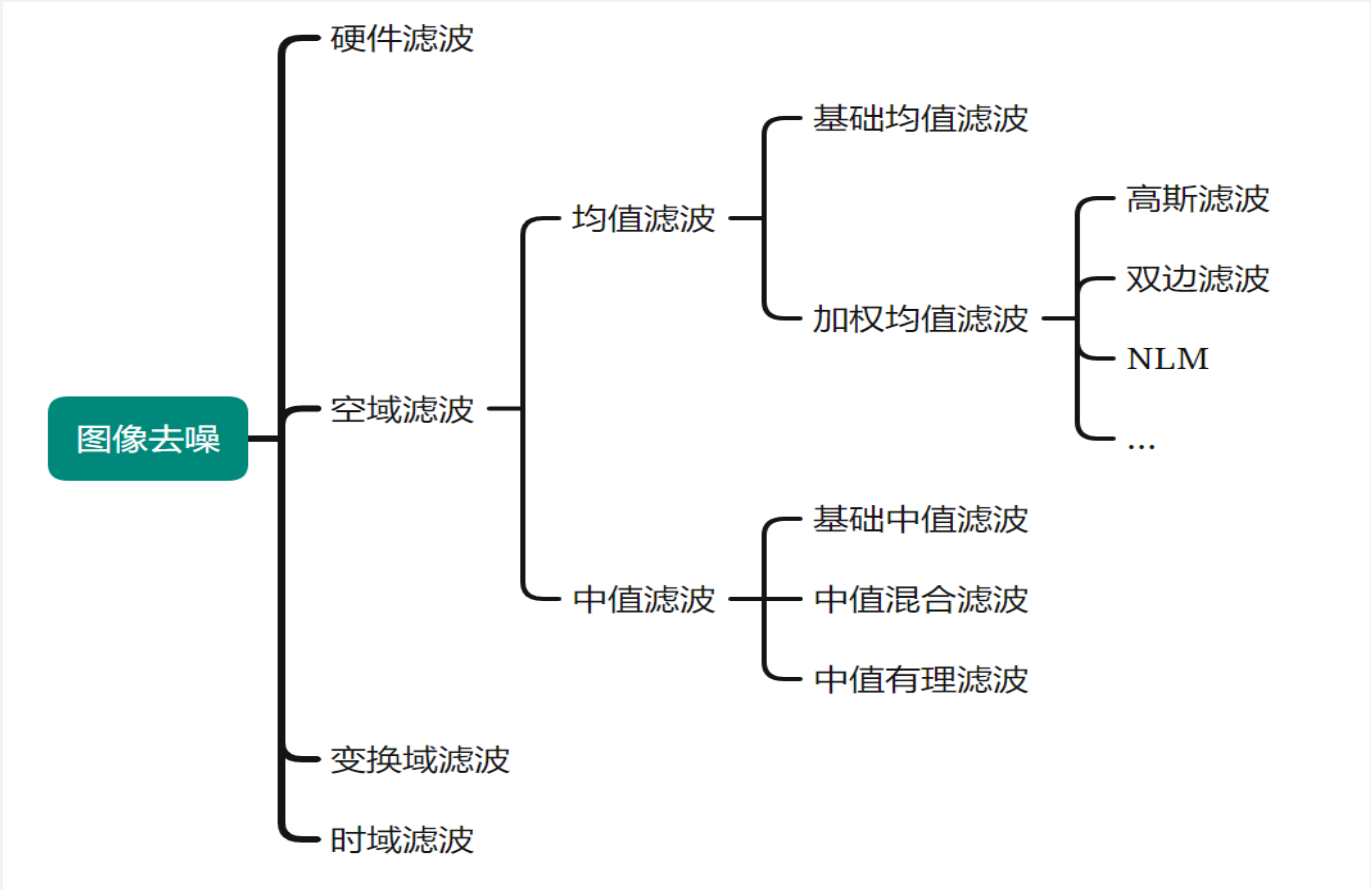
01 产生原因

产生原因

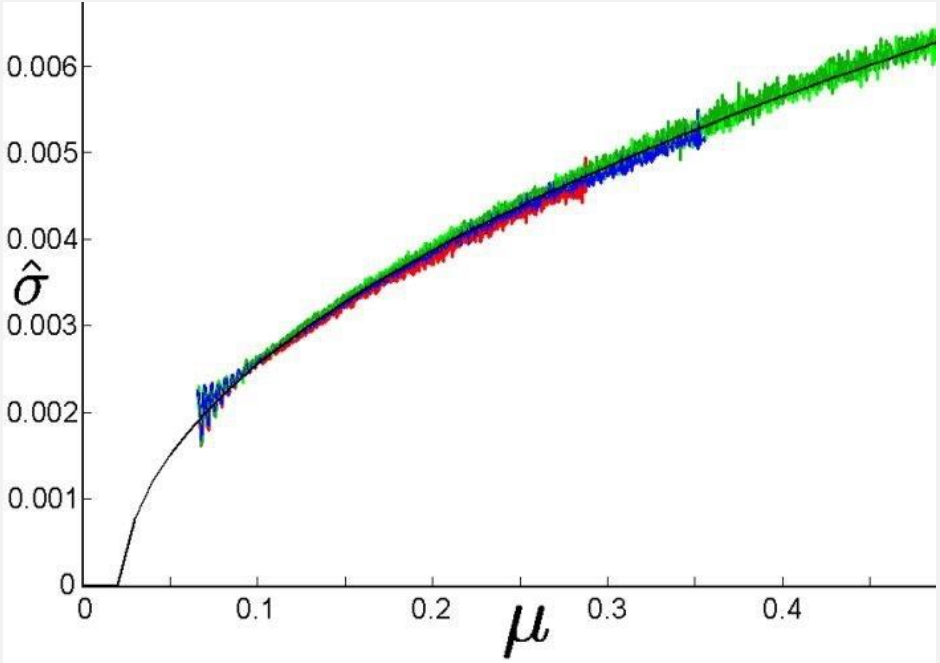

噪声原因
图像获取过程中
由于受传感器材料属性、工作环境、电子元器件和电路结构等影响，会引入各种噪声，如电阻引起的热噪声、场效应管的沟道热噪声、光子噪声、暗电流噪声、光响应非均匀性噪声。
信号传输过程中
由于传输介质和记录设备等的不完善，数字图像在其传输记录过程中往往会受到多种噪声的污染。另外，在图像处理的某些环节当输入的对象并不如预想时也会在结果图像中引入噪声。

02 校正方法

校正方法

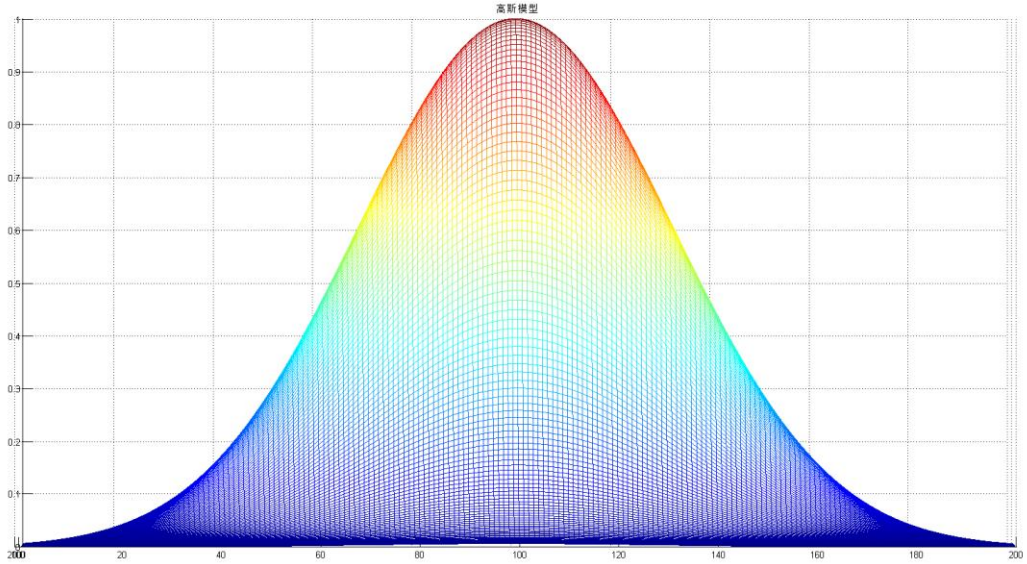

图像去噪
硬件滤波
空域滤波
均值滤波
基础均值滤波
加权均值滤波
高斯滤波
双边滤波
NLM
...
中值滤波
基础中值滤波
中值混合滤波
中值有理滤波
变换域滤波
时域滤波

校正法-均值滤波



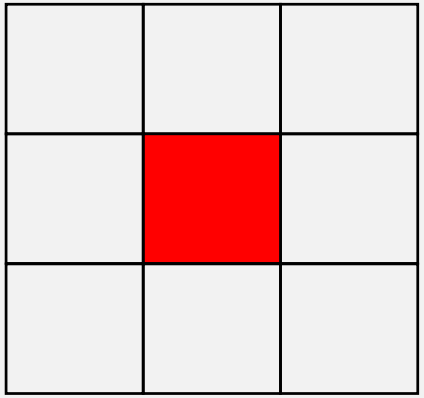
1	1	1
1	1	1
1	1	1

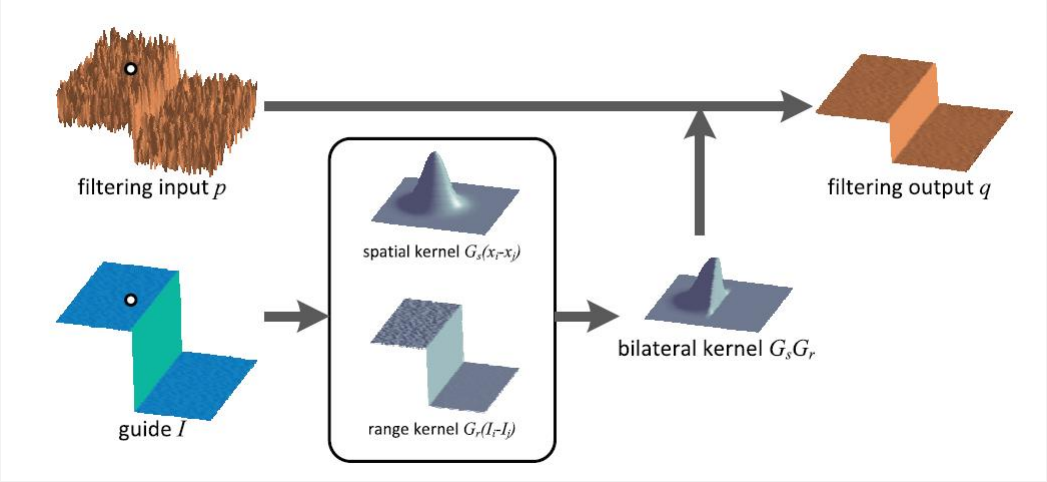
校正法-高斯滤波



0.0751	0.1238	0.0751
0.1238	0.2042	0.1238
0.0751	0.1238	0.0751

校正法-双边滤波





$$I_{\mathbf{p}}^{\mathrm{bf}} = \frac{1}{W_{\mathbf{p}}^{\mathrm{bf}}} \sum_{\mathbf{q}\in\mathcal{S}} G_{\sigma_s}(\|\mathbf{p}-\mathbf{q}\|)\, G_{\sigma_r}(|I_{\mathbf{p}}-I_{\mathbf{q}}|)\, I_{\mathbf{q}} \qquad (1a)$$

$$\text{with} \quad W_{\mathbf{p}}^{\mathrm{bf}} = \sum_{\mathbf{q}\in\mathcal{S}} G_{\sigma_s}(\|\mathbf{p}-\mathbf{q}\|)\, G_{\sigma_r}(|I_{\mathbf{p}}-I_{\mathbf{q}}|) \qquad (1b)$$

The parameter σ_s defines the size of the spatial neighborhood used to filter a pixel, and σ_r controls how much an adjacent pixel is downweighted because of the intensity difference. W^{bf} normalizes the sum of the weights.

校正法-NLM

$$w(i,j) = \frac{1}{Z(i)} e^{-\frac{||v(\mathcal{N}_i) - v(\mathcal{N}_j)||_{2,a}^2}{h^2}},$$

where $Z(i)$ is the normalizing constant

$$Z(i) = \sum e^{-\frac{||v(\mathcal{N}_i) - v(\mathcal{N}_i)||_{2,a}^2}{h^2}}$$

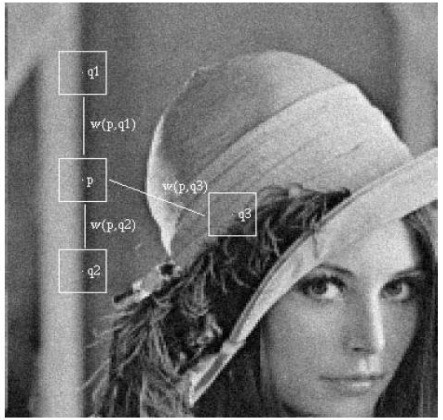
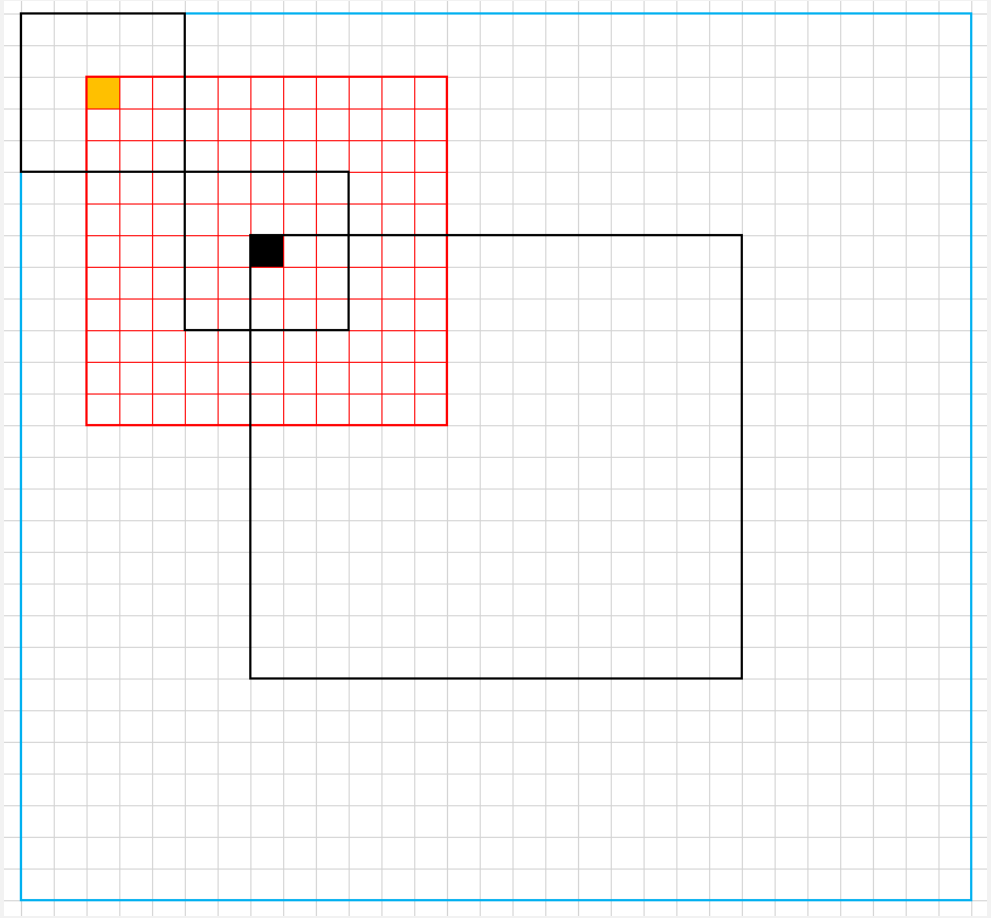


Figure 1. Scheme of NL-means strategy. Similar pixel neighborhoods give a large weight, w(p,q1) and w(p,q2), while much different neighborhoods give a small weight w(p,q3).



03 代码实现

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See You !