BNR-Bayer Noise Reduce(下)

Noise Reduction for CFA Image Sensors Exploiting HVS Behaviour

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202112

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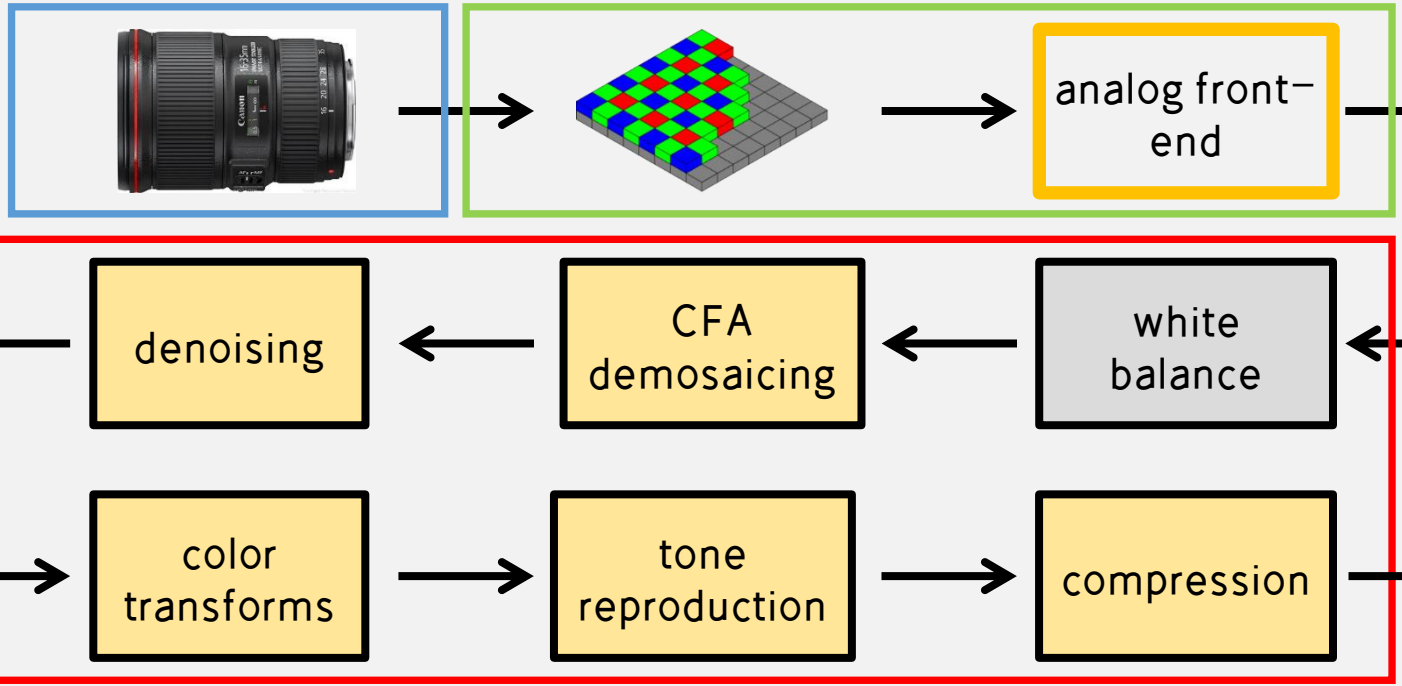
01 噪声模型

噪声模型

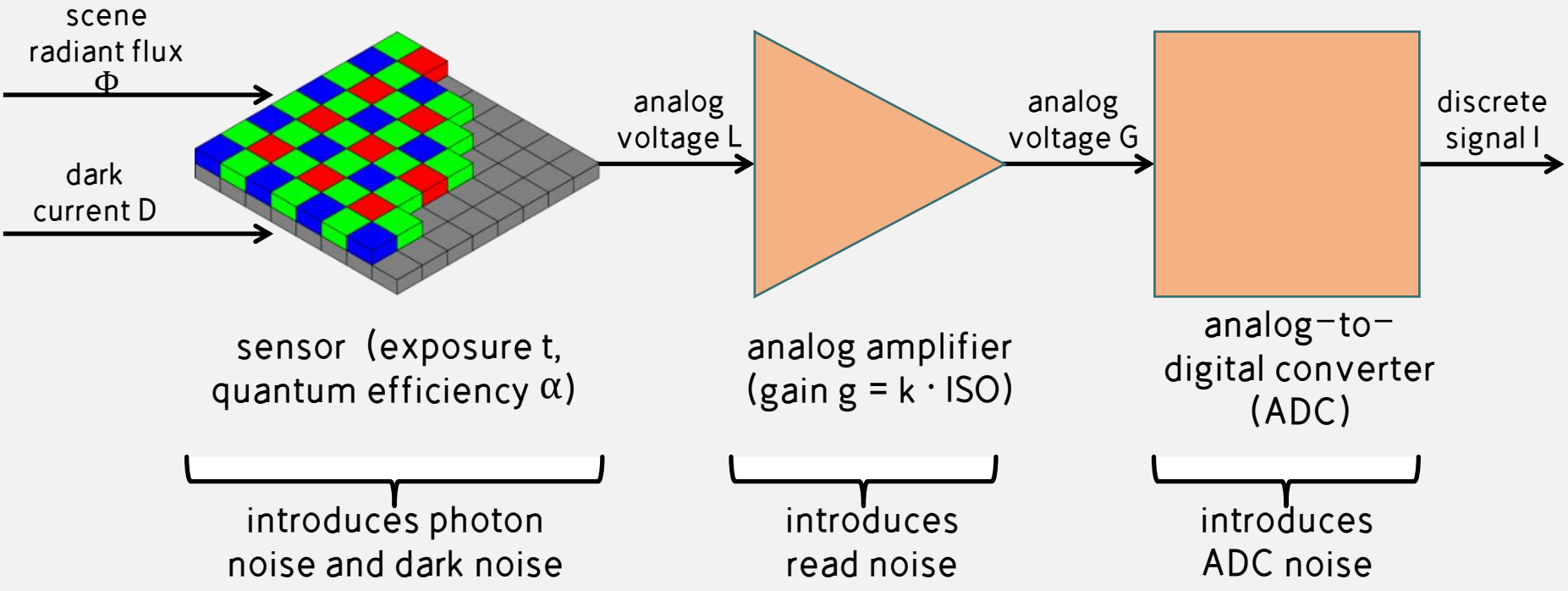
Which part introduces noise?

- Noise is introduced in the green part.



Ref: CMU 2020 Fall Computational Photography Course 15-463, Lecture

噪声模型

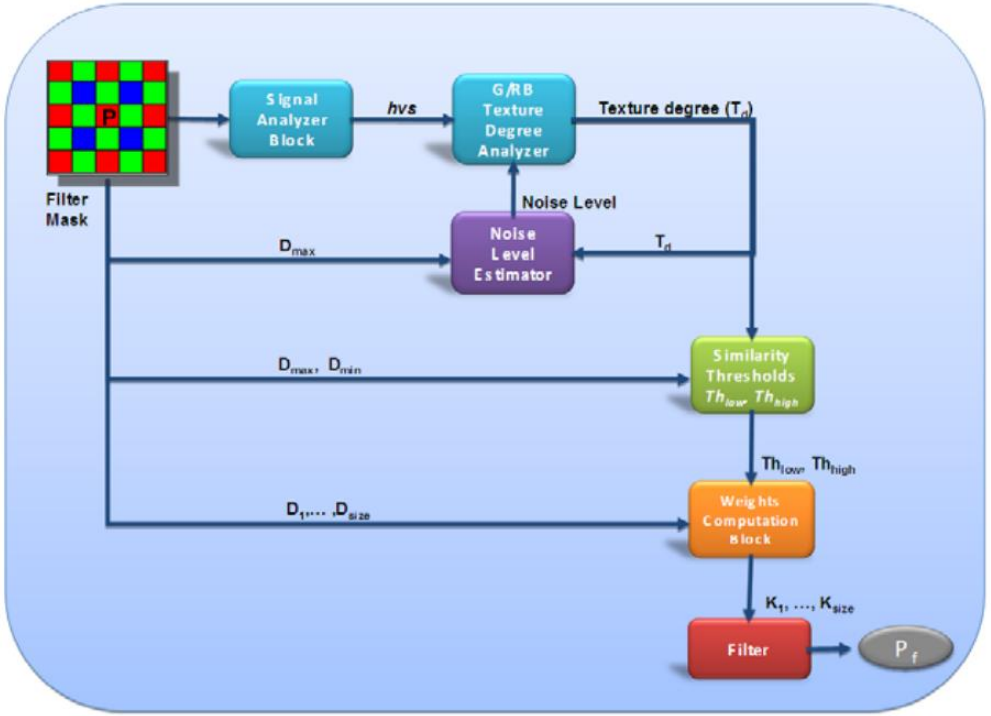


Ref: CMU 2020 Fall Computational Photography Course 15-463, Lecture 7

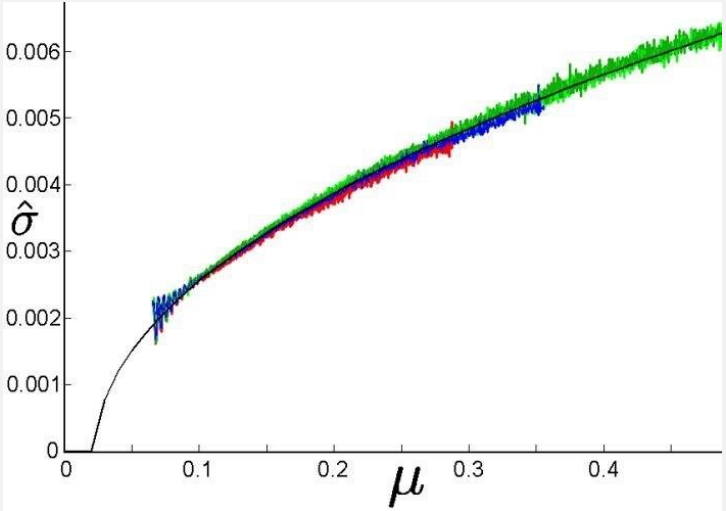
02 算法原理

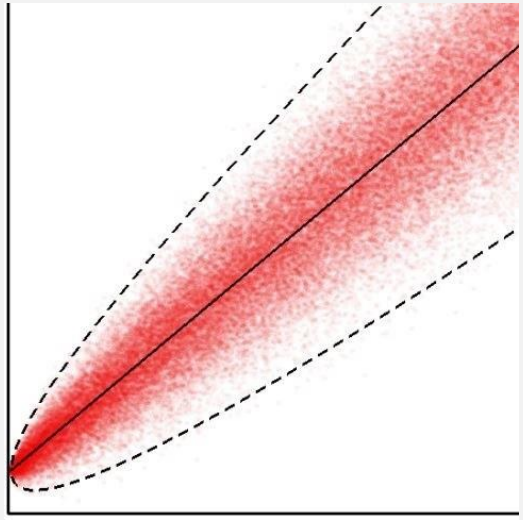
算法原理–整体框架

Figure 2. Overall Filter Block Diagram.



算法原理-Signal Analyzer Block





算法原理-Signal Analyzer Block

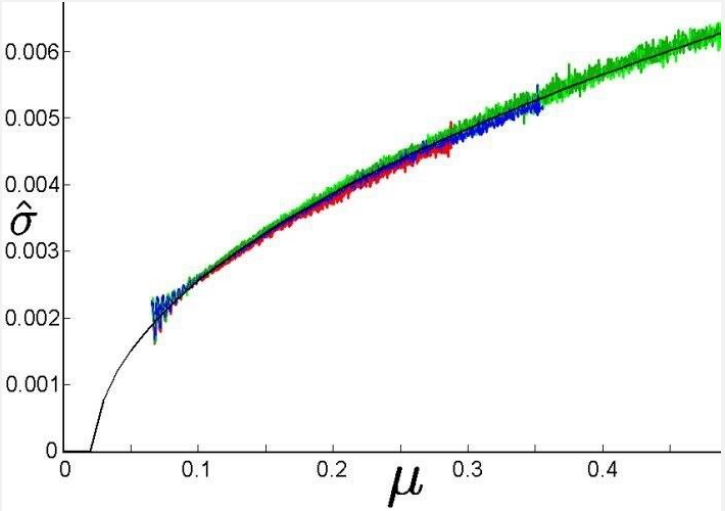
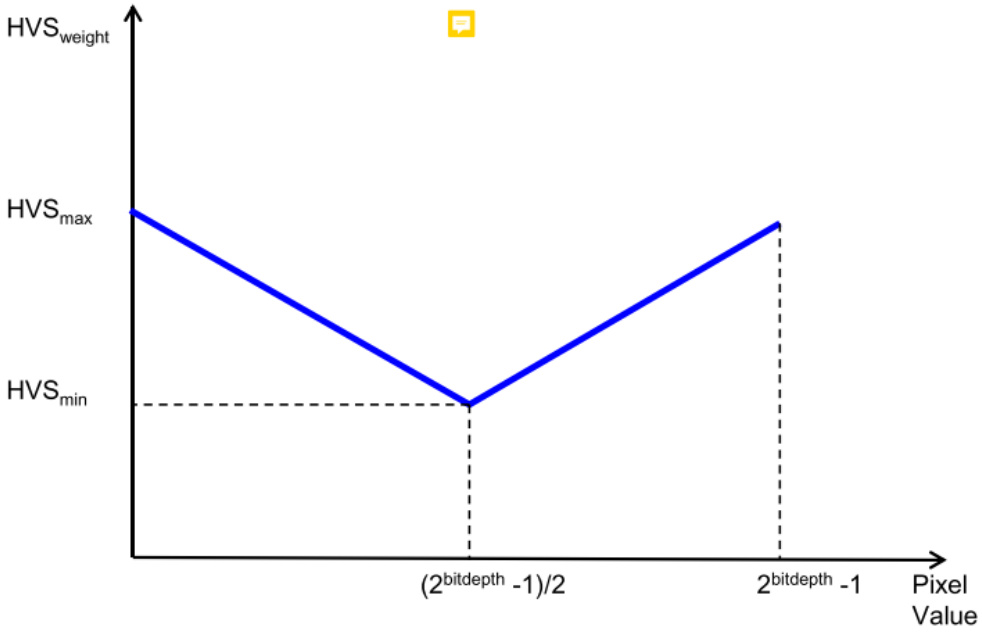


Figure 3. HVS curve used in the proposed approach.



算法原理-Texture Degree Analyzer

Figure 5. Green Texture Analyzer.

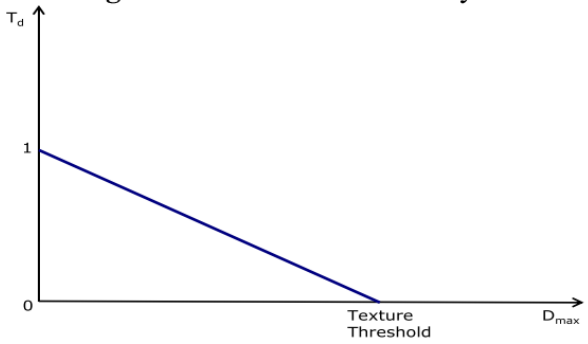
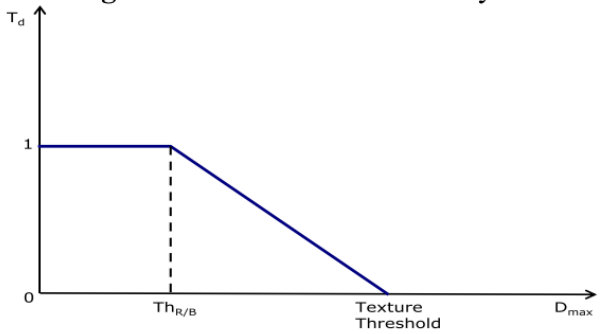


Figure 6. Red/Blue texture analyzer.



$$T_d(green) = \begin{cases} 1 & D_{\max} = 0 \\ -\dfrac{D_{\max}}{TextureThreshold} + 1 & 0 < D_{\max} \le TextureThreshold \\ 0 & D_{\max} > TextureThreshold \end{cases}$$

$$T_d(red/blue) = \begin{cases} 1 & D_{\max} \le Th_{R/B} \\ -\dfrac{(D_{\max} - Th_{R/B})}{(TextureThreshold - Th_{R/B})} + 1 & Th_{R/B} < D_{\max} \le TextureThreshold \\ 0 & D_{\max} > TextureThreshold \end{cases}$$

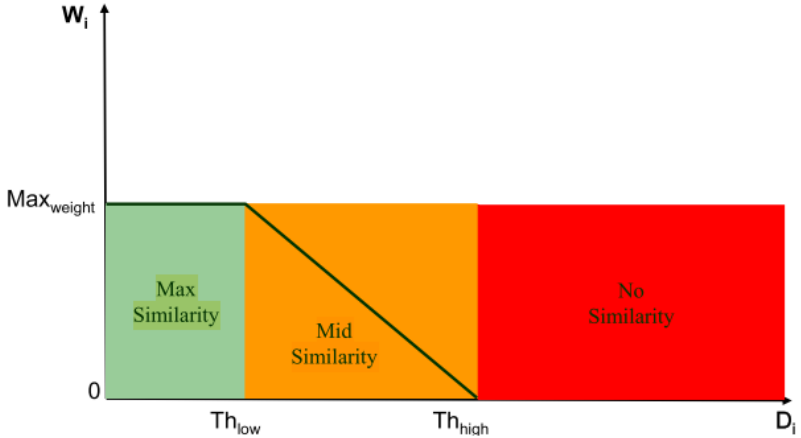
$$TextureThreshold_c\ (k) = HVS_{weight}(k) + NL_c(k\text{-}1)$$

算法原理-Noise Level Estimator

1. if the local area is completely flat（Td = 1）, then the noise level is set to Dmax；
2. if the local area is highly textured（Td = 0）, the noise estimation is kept equal to the previous region（i.e., pixel）；
3. otherwise a new value is estimated

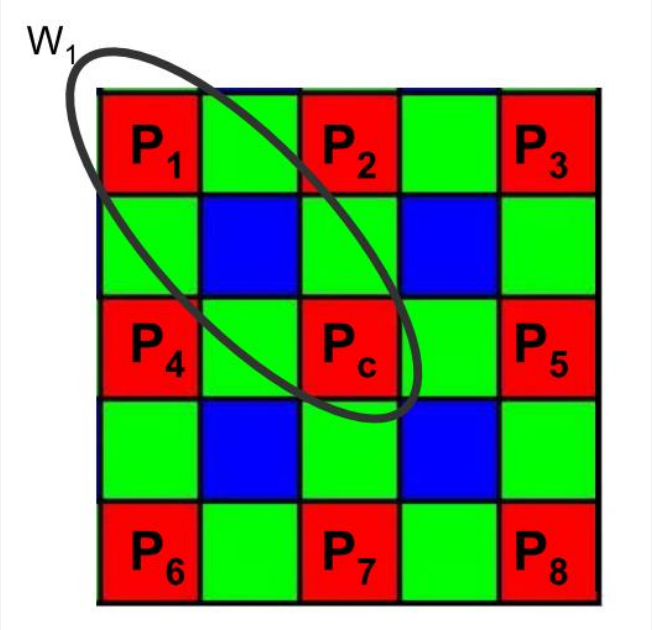
$$NL_R(k) = T_d(k) * D_{\max}(k) + [1 - T_d(k)] * NL_R(k-1)$$
$$NL_G(k) = T_d(k) * D_{\max}(k) + [1 - T_d(k)] * NL_G(k-1)$$
$$NL_B(k) = T_d(k) * D_{\max}(k) + [1 - T_d(k)] * NL_B(k-1)$$

算法原理-Similarity Thresholds and Weighting Coefficients computation



$$
\begin{cases}
Th_{low} = Th_{high} = D_{\max} \quad if \quad T_d = 1 \\
Th_{low} = D_{\min} \quad if \quad T_d = 0 \\
Th_{high} = \dfrac{D_{\min} + D_{\max}}{2} \quad if \quad T_d = 0 \\
D_{\min} < Th_{low} < Th_{high} \quad if \quad 0 < T_d < 1 \\
\dfrac{D_{\min} + D_{\max}}{2} < Th_{high} < D_{\max} \quad if \quad 0 < T_d < 1
\end{cases}
$$

算法原理-Final Weighted Average



$$P_f = \frac{1}{N}\sum_{i=1}^{N}\left[W_i P_i + (1 - W_i)P_c\right]$$

03 算法实现

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See You !