Adaptive Filters

Smoothing

Adaptive Filters

1. Adaptive, local noise reduction filter

2. Adaptive median filter
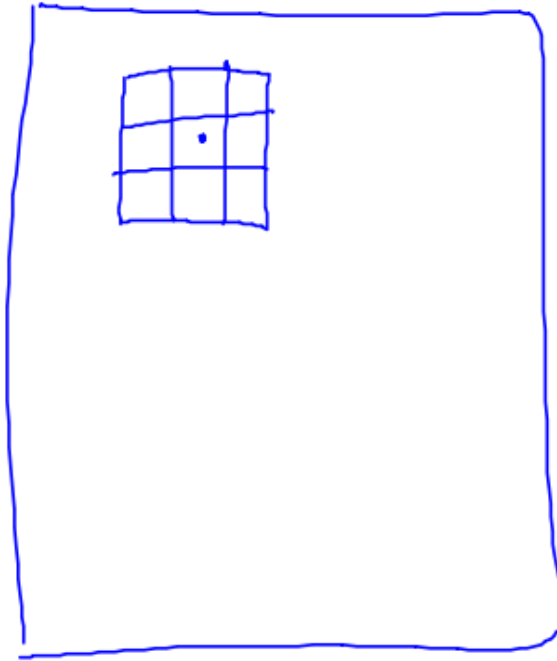
Adaptive, local noise reduction filter

$g(x, y)$

σ_N^2

σ_L^2

m_L

Adaptive, local noise reduction filter

① $\quad \sigma_N^2 = 0 \quad ; \quad \hat{f}(x,y) = g(x,y)$

② $\quad \sigma_N^2 < \sigma_L^2 \quad ; \quad \hat{f}(x,y) \approx g(x,y)$

③ $\quad \sigma_N^2 = \sigma_L^2 \quad ; \quad \hat{f}(x,y) \leftarrow \text{Arithmatic filter}$

Adaptive, local noise reduction filter

$$\hat{f}(x,y) = g(x,y) - \frac{\sigma_N^2}{\sigma_L^2}\left[g(x,y) - m_L\right]$$
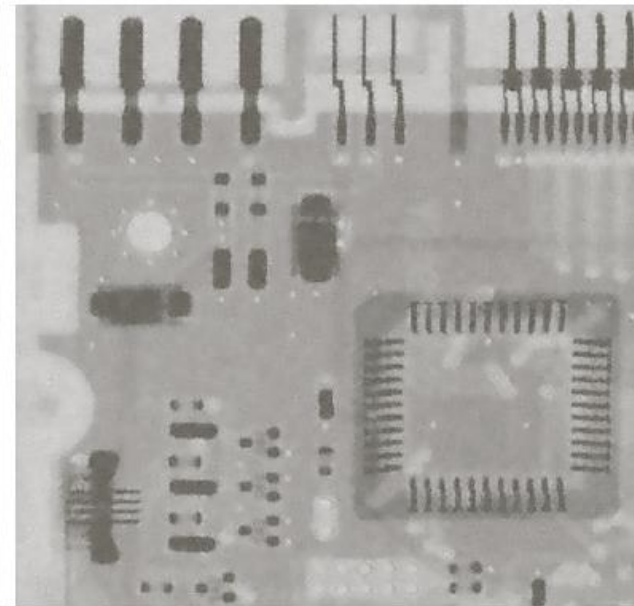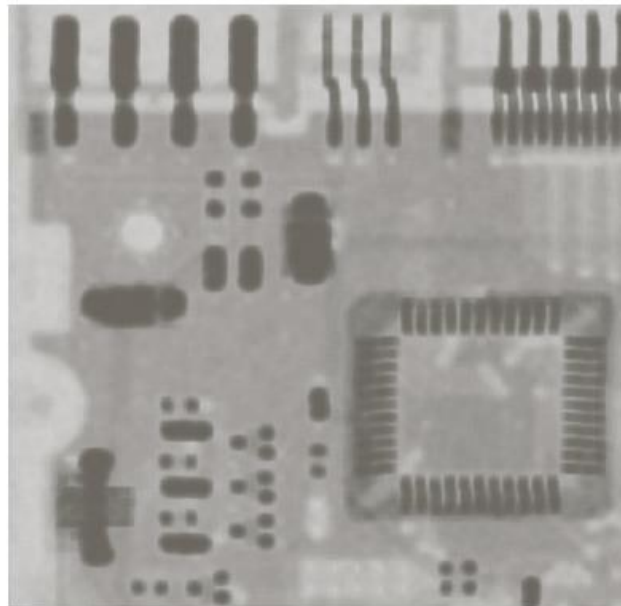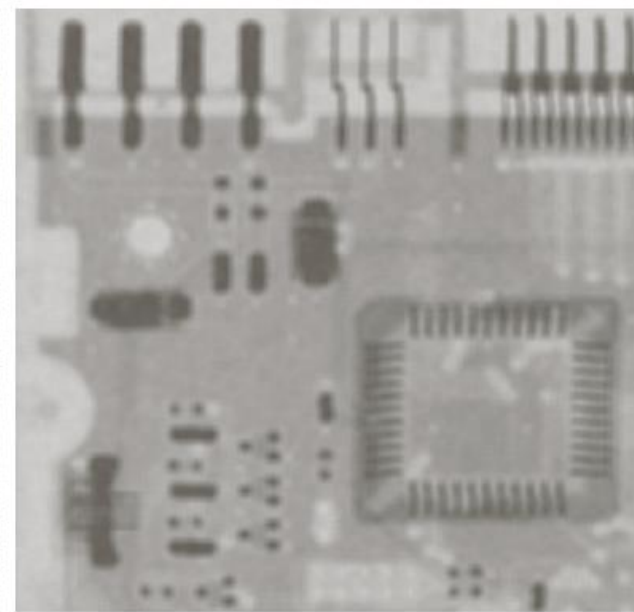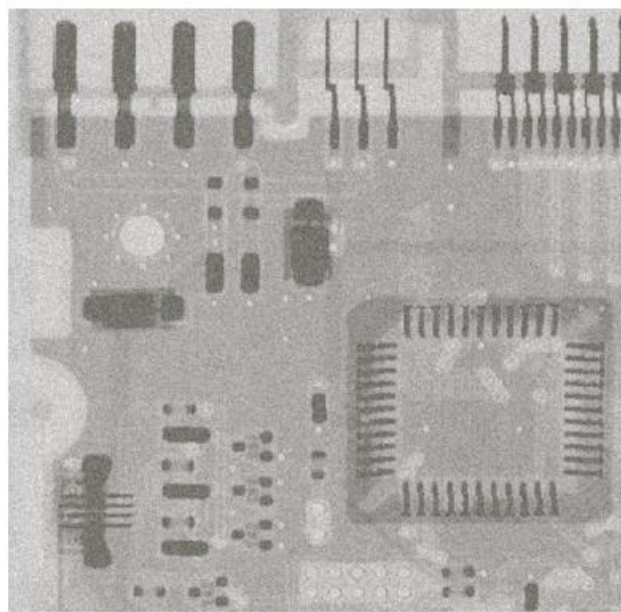
Adaptive, local noise reduction filter

FIGURE 5.13
(a) Image corrupted by additive Gaussian noise of zero mean and variance 1000.
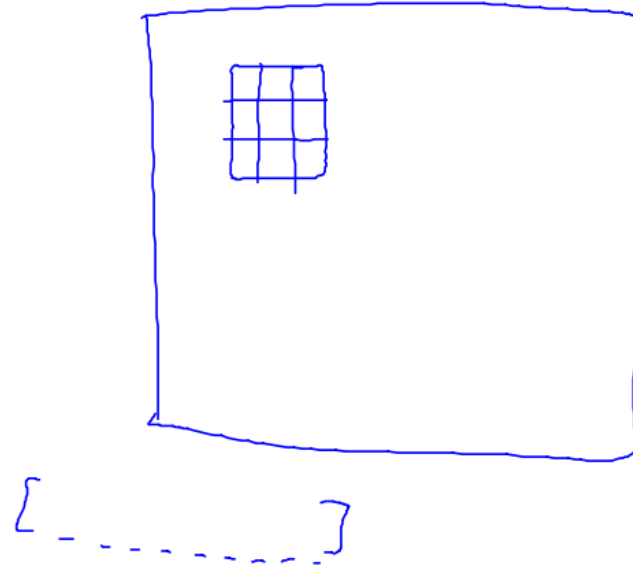(b) Result of arithmetic mean filtering.
(c) Result of geometric mean filtering.
(d) Result of adaptive noise reduction filtering. All filters were of size 7×7.

Adaptive median filter

Adaptive median filter

$$Z_{min} \longrightarrow \text{min intensity in } S_{xy}$$

$$Z_{max} \longrightarrow \text{max. } \quad ,,$$

$$Z_{med} \longrightarrow \text{median } \quad ,,$$

$$Z_{x,y} \longrightarrow \text{Intensity at } (x,y)$$

$$S_{max} \longrightarrow \text{max. allowed size of } S_{xy}$$

Adaptive median filter

Stage A

$$A_1 = Z_{med} - Z_{min}$$

$$A_2 = Z_{med} - Z_{max}$$

if $A_1 > 0$ AND $A_2 < 0$ go to stage B

else increase window size

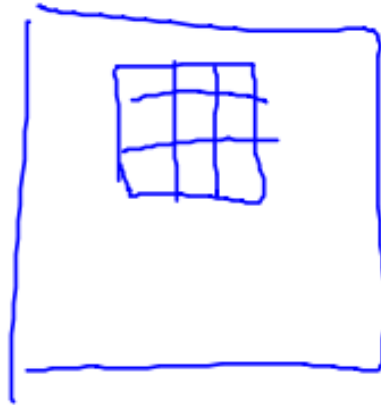if window size $\leq S_{max}$ repeat A
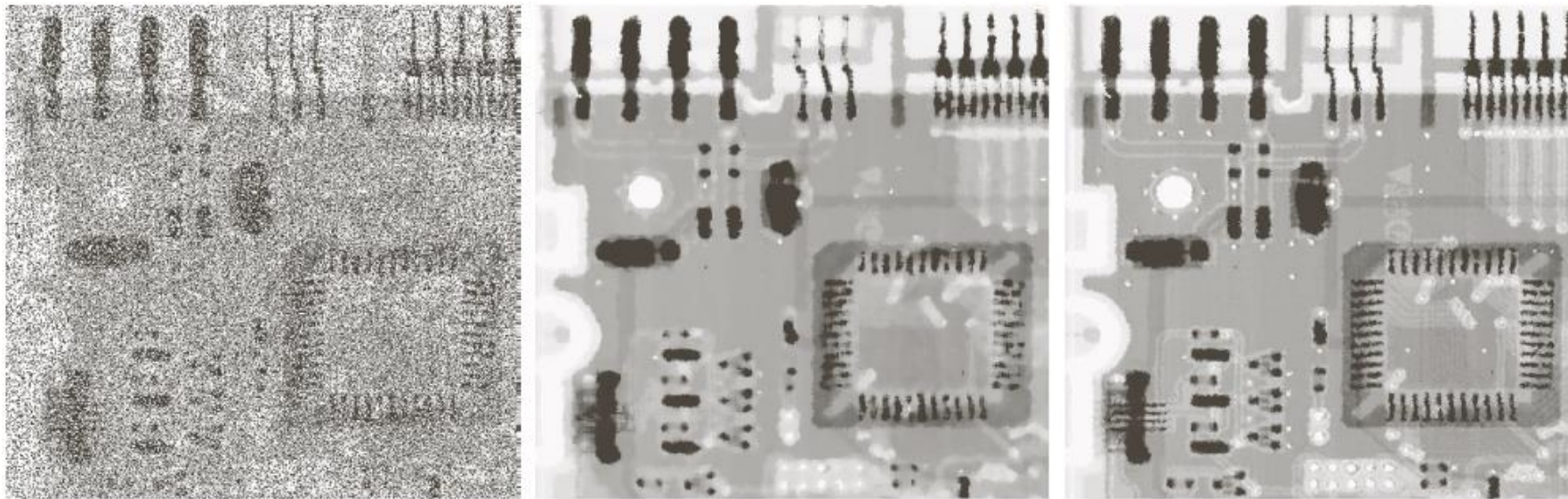
else output Z_{med}

Stage B

$$B_1 = Z_{xy} - Z_{min}$$

$$B_2 = Z_{xy} - Z_{max}$$

If $B_1 > 0$ AND $B_2 < 0$; output Z_{xy}

else output Z_{med}

Adaptive median filter

a b c

FIGURE 5.14 (a) Image corrupted by salt-and-pepper noise with probabilities $P_a = P_b = 0.25$. (b) Result of filtering with a 7×7 median filter. (c) Result of adaptive median filtering with $S_{max} = 7$.