15EEE337 Digital Image Processing

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Last Lecture

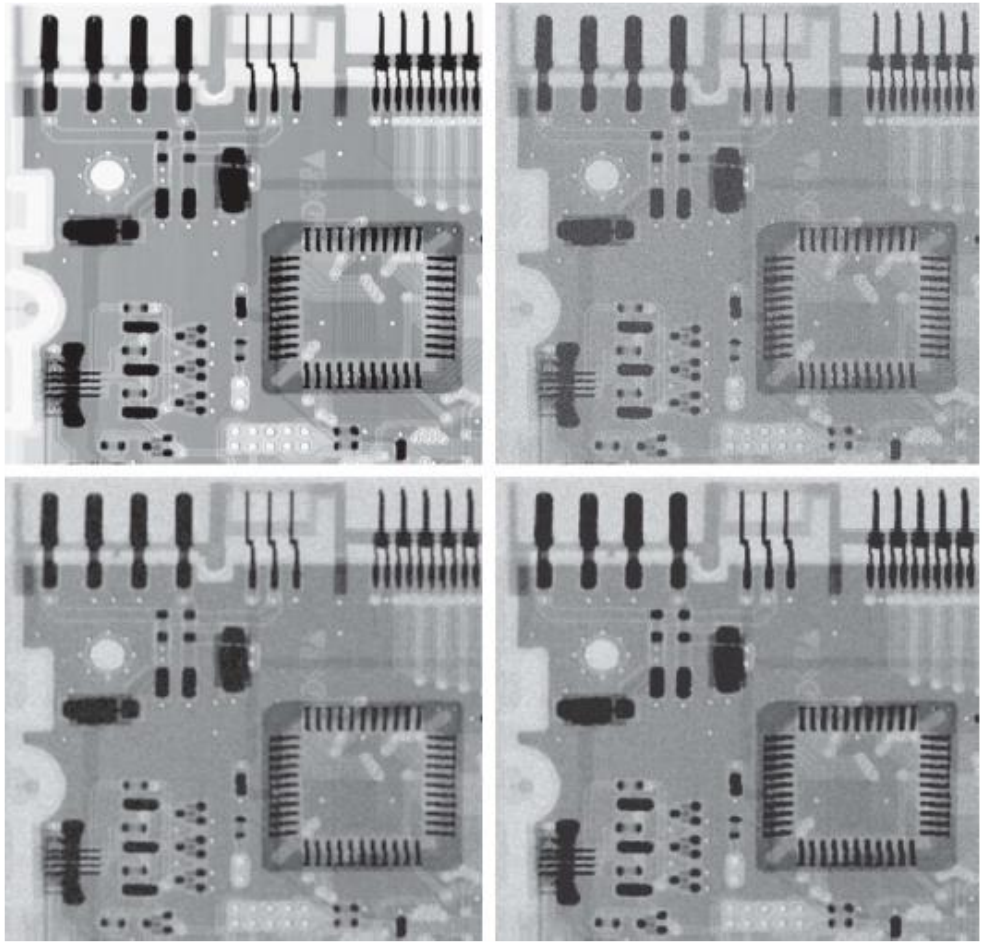
- Image restoration
- Noise model
- Image denoising-Mean Filter

Mean Filter-Geometric Mean Filter

- An image restored using a geometric mean filter is given by the expression

$$\hat{f}(x,y) = \left[\prod_{(r,c) \in S_{xy}} g(r,c) \right]^{\frac{1}{mn}}$$

  - *each* restored pixel is given by the product of *all* the pixels in the sub image area.



(a) X-ray image of circuit board. (b) Image corrupted by additive Gaussian noise. (c) Result of filtering with an arithmetic mean filter of size 3×3. (d) Result of filtering with a geometric mean filter of the same size.

Order statistic filters

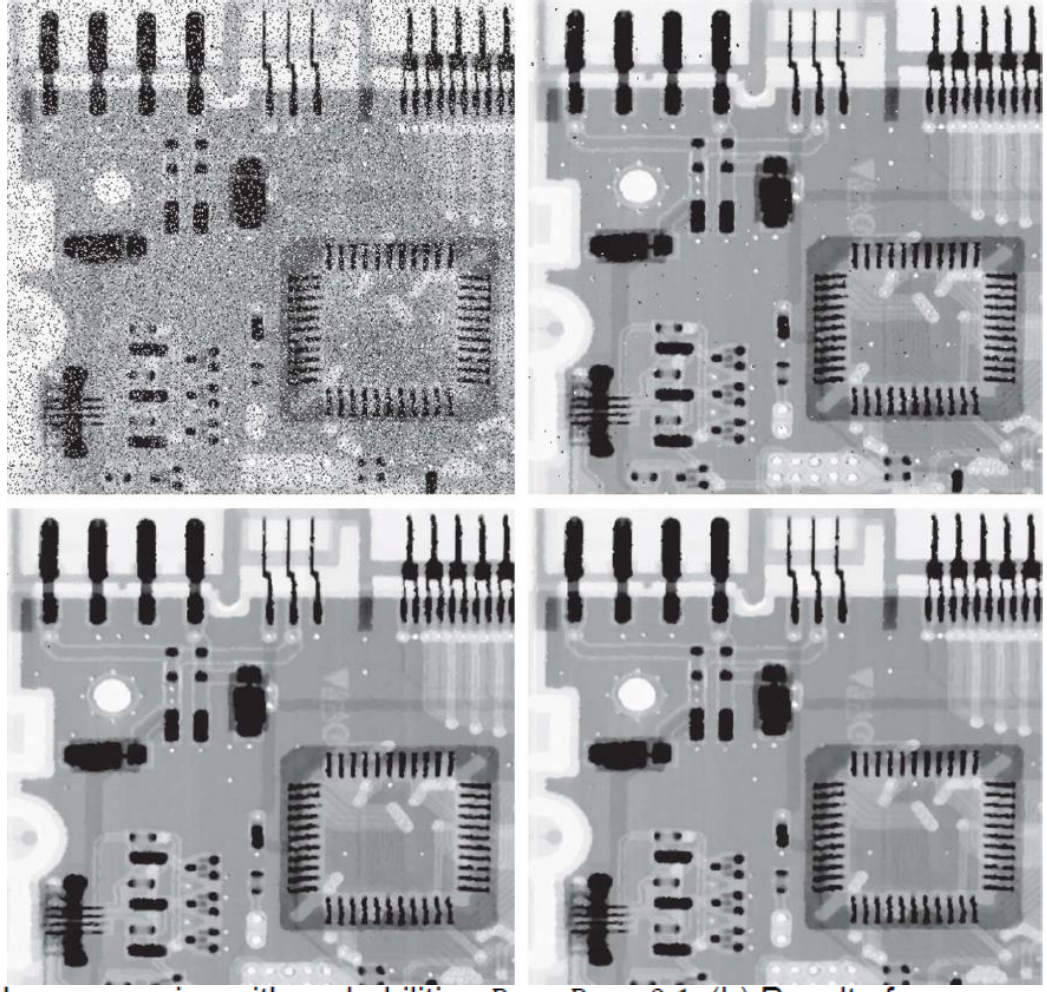
- Ordering the values of the pixels in the neighborhood contained by the filter.
- **Median** Filter-replaces the value of a pixel by the median of the intensity levels in a predefined neighborhood of that pixel. Median filters are quite popular because, for certain types of random noise, they provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size.

$$\hat{f}(x,y) = \underset{(r,c) \in S_{xy}}{\text{median}} \{g(r,c)\}$$

- **Max and min filters**
- The median represents the 50th percentile of a ranked set of numbers
- 100th percentile results in the so-called max filter
- This filter is useful for finding the brightest points in an image or for eroding dark regions adjacent to bright areas
- The 0th percentile filter is the min filter
- This filter is useful for finding the darkest points in an image or for eroding light regions adjacent to dark areas.
- Also, it reduces salt noise as a result of the min operation

$$\hat{f}(x,y) = \max_{(r,c) \in S_{xy}} \{g(r,c)\}$$

$$\hat{f}(x,y) = \min_{(r,c) \in S_{xy}} \{g(r,c)\}$$



(a) Image corrupted by salt-and-pepper noise with probabilities $P_s = P_p = 0.1$. (b) Result of one pass with a median filter of size 3×3. (c) Result of processing (b) with this filter. (d) Result of processing (c) with the same filter.


THANK
YOU