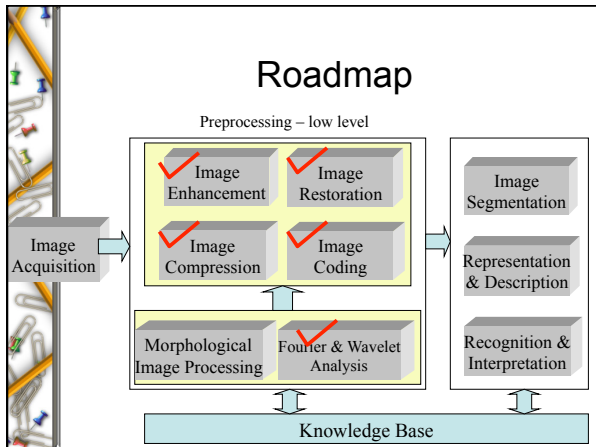


ECE472/572 - Lecture 14

Morphological Image Processing

11/17/11



Roadmap

- Color image processing
 - Interpreting color
 - Pseudo-color IP
 - Full-color IP
 - Total vs. Color correction
 - Enhancement and restoration (I vs. RGB channels)
 - Color image edge detection
- Image compression
 - Concept
 - Data vs. information
 - Entropy
 - 3 types of data redundancy
 - Fidelity measurement
 - Lossless compression
 - Variable length coding (Huffman coding)
 - LZW
 - Biplane coding
 - Binary image compression (RLC)
 - Lossless predictive coding
 - Lossy compression
 - Lossy predictive coding
 - JPEG
- Wavelet analysis
 - WT vs. FT vs. STFT
 - Time vs. Frequency resolution
 - DWT
- Binary morphological image processing
 - Morphological operators
 - Dilation
 - Erosion
 - Opening
 - Closing
 - Morphological filter
 - Hit-or-miss
- Gray-scale morphological image processing
- Applications

Questions

- What is SE?
- How to get the following effects
 - a sunken effect,
 - a relief effect,
 - the boundary
 - Remove noise in the background
 - Remove noise in the foreground
 - Link edges
 - Denoising in general
 - Shape recognition
 - Filling holes (conditional dilation)

Morphology

- Pre- and post-processing
 - Morphological filter
- Extract image components that are useful in the representation and description
 - Boundary
 - Skeleton

2

2

2

2

Morphological Operators - Dilation

$$A \oplus B = \{a + b \mid a \in A, b \in B\}$$

A = {(2,8),(3,6),(4,4),
(5,6),(6,4),(7,6),(8,8)}

B = {(0,0),(0,1)}

A+B = {(2,8),(3,6),(4,4),
(5,6),(6,4),(7,6),(8,8),
(2,9),(3,7),(4,5),(5,7),
(6,5),(7,7),(8,9)}

B: structuring element (s.e)
Always includes (0,0)

Morphological Operators - Erosion

$$A \ominus B = \{a \mid (a + b) \in A \text{ for every } a \in A, b \in B\}$$

Example

Other Morphological Operators

- Opening

$$A \circ B = A \ominus B \oplus B$$
- Closing

$$A \bullet B = A \oplus B \ominus B$$
- Application???

Example

2

2

?

Opening

2

2

Closing

Morphological Filter (opening + closing)

2

2

2

2

2

Application – Edge Linking

Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.

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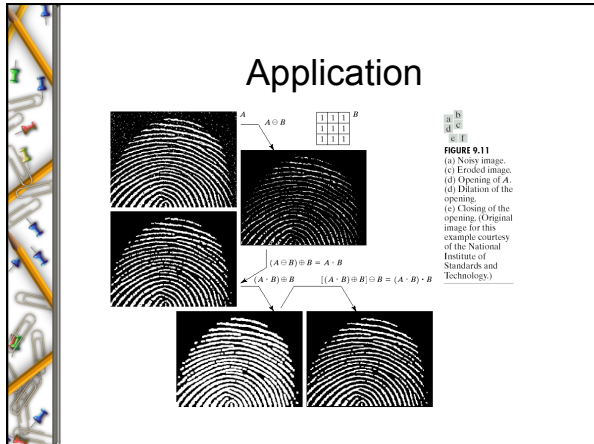
FIGURE 9.5
 (a) Simple text of poor resolution with broken characters (magnified view).
 (b) Structuring element.
 (c) Dilation of (a) by (b). Broken segments were joined.

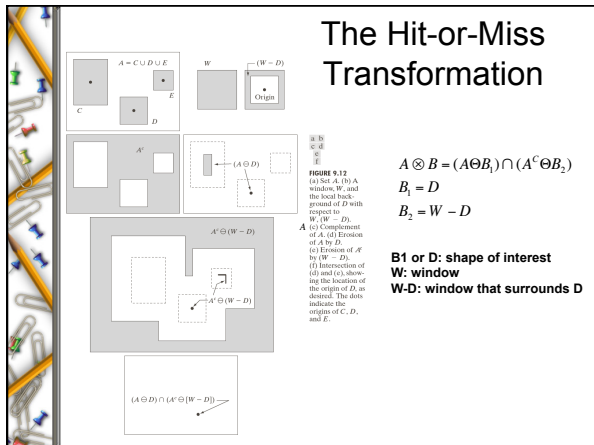
ea

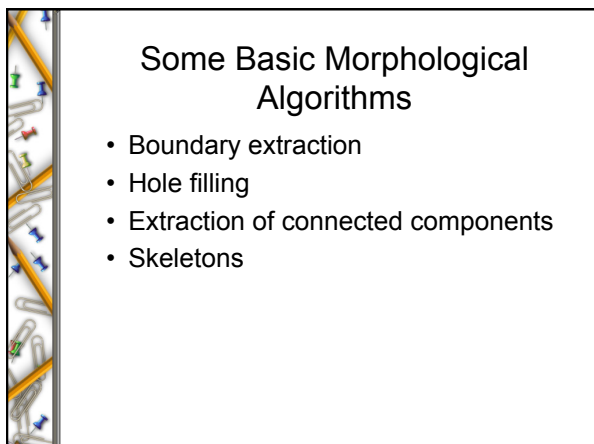
→

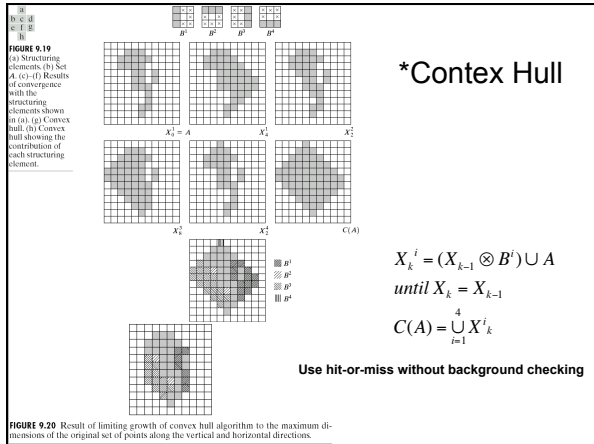
ea


0	1	0
1	1	1
0	1	0











Gray-scale Morphology

- Dilation
 - Finding max in the neighborhood
- Erosion
 - Finding min in the neighborhood
