

Medical Image Retrieval / Image (Pre-)Processing

Thomas Deselaers, Henning Müller

Tutorial “Medical Image Retrieval” Medical Informatics Europe – 28. August 2005

Human Language Technology and Pattern Recognition
Lehrstuhl für Informatik VI
Computer Science Department
RWTH Aachen University, Germany

Relevance for CBIR

use of image (pre-) processing for CBIR:

- normalization of brightness/position**
- extraction of visual features**
- image comparison**

Digital Images

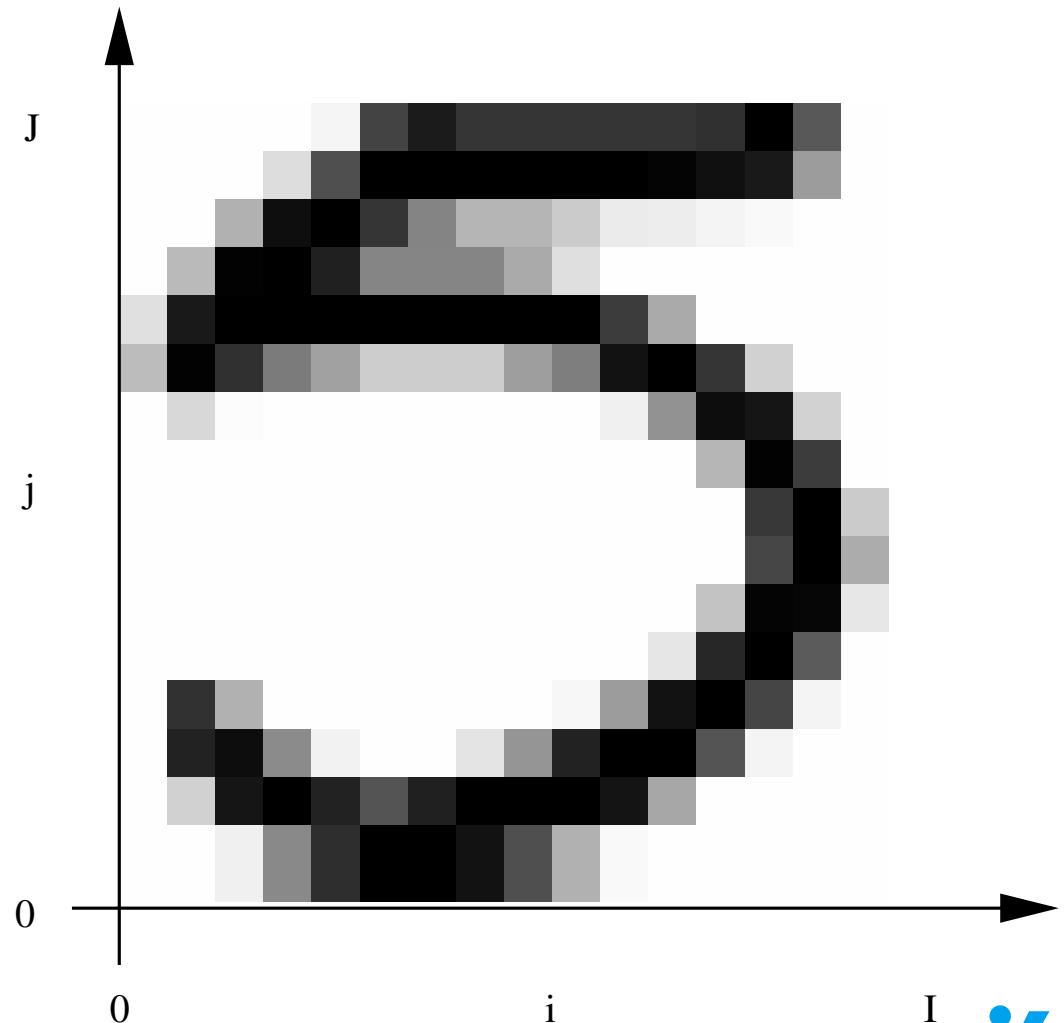
image capture and discretization: not discussed here

image $X : \{1, \dots, I\} \times \{1, \dots, J\} \longrightarrow \{0, \dots, G - 1\} : X(i, j) = X_{ij}$

more than two dimensions:
volumes, image sequences

more than one value per pixel:
color images or several measurements:
vector valued functions

other relevant aspects:
color spaces, file types, ...



Point Operators

point operators:

$$f(X)(i, j) = f(X(i, j))$$

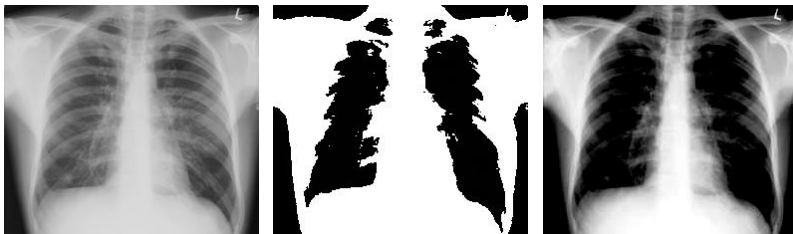
example: gamma correction

$$X'(i, j) = (G - 1) \cdot [X(i, j)/(G - 1)]^{1/\gamma}$$



other point operators:

binarization, contrast stretching



Other Operations

local support:

- linear filters, e.g. gradient operator (Sobel)
- mean and median filter
- ...

geometric operations:

- change not the pixel value, but its position
- translation, scaling, rotation, shearing, ...
 - discretized structure makes interpolation necessary

complete image:

- histogram normalization
- ...

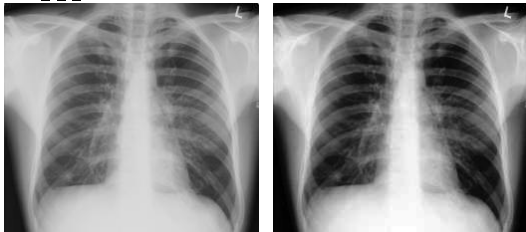


Image Processing for Feature Extraction

feature extraction at the pixel level:

- **Sobel operator (gradient)**
- **local variance**
- **local orientation**
- **Tamura texture features**
- **Gabor filter responses**
- ...

Image Segmentation

segmentation

- **produces binary image**
- **is at the threshold between image processing and image analysis**

different approaches:

- **pixel-based**
- **region-based**
- **edge-based**
- **model-based**

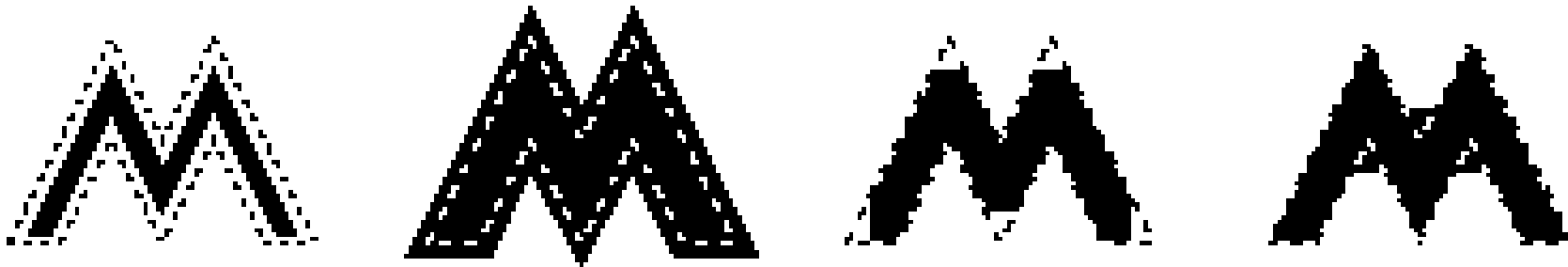
**usually high level knowledge of the image content is needed
(segmentation is strongly related to content understanding)**

Morphological Operators

morphological operators operate on binary images
using a structure element

erosion
dilation

[erosion,dilation]=opening
[dilation,erosion]=closing



thinning = erosion, but don't break or delete objects

Shape Features

**shape features assume given outer contour of object
(often difficult!)**

possible derived measures/features:

- moments
- Fourier descriptors
- area
- perimeter
- circularity
- bounding box
- ...

Further Relevant Topics

- averaging
- edge detection
- template matching
- FFT, frequency analysis, windowing
- structure tensor, optical flow