Morphological Feature Extraction of Image

Kirti Mandloi (0801CS171035)

gs0801cs171035@sgsitsindore.in

December 20, 2020

Contents

Chapter 1

1 Introduction

1.1 Morphological Image Processing

The field of mathematical morphology contributes a wide range of operators to image processing, all based around a few simple mathematical concepts from set theory. It is a collection of non-linear operations related to the shape or morphology of features in an image, such as boundaries, skeletons, etc. Morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images, but if needed color images can be converted to binary for further processing. For a binary image, white pixels are normally taken to represent foreground regions, while black pixels denote background.

1.2 Applications

Mathematical Morphological operations are used to extract image components that are useful in the representation and description of region shape, such as

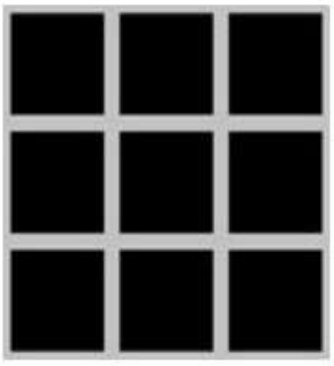
- boundaries extraction
- skeletons
- convex hull
- morphological filtering
- thinning
- region filling
- noise removal
- Medical images processing

Chapter 2

Mathematical Formulation

2.1 Structuring Element

An essential part of the morphological operations is the structuring element used to probe the input image. A structuring element is a matrix that identifies the pixel in the image being processed and defines the neighborhood used in the processing of each pixel. We typically choose a structuring element based on size and shape of the objects we want to process .In many implementations of morphological operators, the structuring element is assumed to be a particular shape and so is hardwired into the algorithm. Example: 3 X 3 square (SE)
In practical , it is matrix of 1's and 0's.

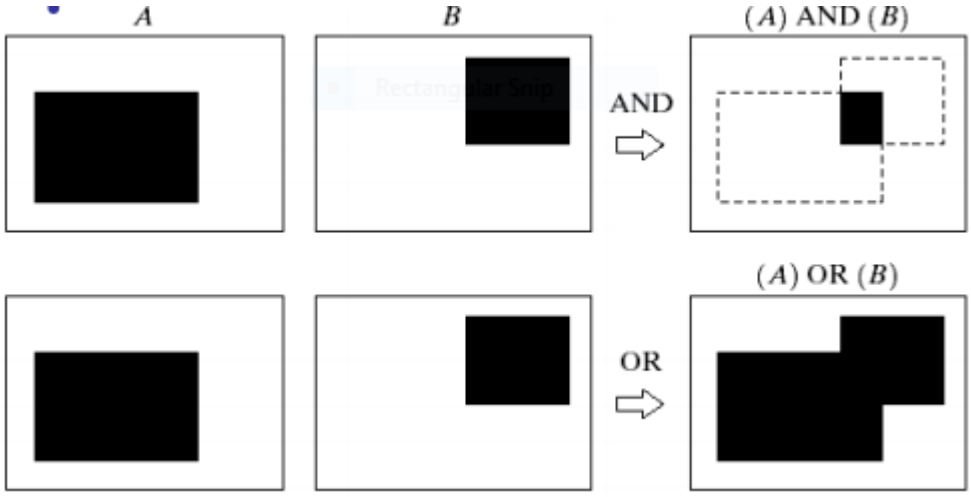


Structure Element(S)

2.2 Formulation

Morphological operators often take a binary image and a structuring element as input and combine them using a set operator (intersection, union, inclusion, complement).

Example:



1. **Dilation**

   Dilation adds pixels to the boundaries of objects in an image. The basic effect of the operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels (*i.e.* white pixels, typically). Thus areas of foreground pixels grow in size while holes within those regions become smaller.

   The dilation of an image *A* by a structuring element *s* (denoted $A \oplus B$) produces a new binary image $g = A \oplus B$ with ones in all locations (x,y) of a structuring element's origin at which that structuring element *b* hits the the input image *A*, i.e. $g(x,y) = 1$ if *B* hits *A* and 0 otherwise, repeating for all pixel coordinates (x,y).

$$A \oplus B = \{z | (\hat{B})_z \cap A \neq \Phi\}$$

.

2. Erosion

The basic effect of the operator on a binary image is to erode away the boundaries of regions of foreground pixels (*i.e.* white pixels, typically). Thus areas of foreground pixels shrink in size, and holes within those areas become larger. The value of the output pixel is the minimum value of all pixels in the neighborhood. In a binary image, a pixel is set to 0 if any of the neighboring pixels have the value 0.

The erosion of a binary image *A* by a structuring element *B* (denoted $A \ominus B$) produces a new binary image $g = A \ominus B$ with ones in all locations (*x,y*) of a structuring element's origin at which that structuring element *B* fits the input image *A*, i.e. *g(x,y)* = 1 is *B* fits *A* and 0 otherwise, repeating for all pixel coordinates (*x,y*).

$$A \ominus B = \{z | (B)_z \subseteq A\}$$

3. **Opening** :

The opening operation erodes an image and then dilates the eroded image, using the same structuring element for both operations. Morphological opening is useful for removing small objects from an image while preserving the shape and size of larger objects in the image.
Any regions that have survived the erosion are restored to their original size by the dilation

$$A \circ B = (A \ominus B) \oplus B$$

4. Closing

The closing operation dilates an image and then erodes the dilated image, using the same structuring element for both operations. Morphological closing is useful for filling small holes from an image while preserving the shape and size of the objects in the image. It fuses narrow breaks, thin gulfs and smoothen contours.

$$A \bullet B = (A \oplus B) \ominus B$$

5. Perimeter

This performs boundary extraction of image. In this first the image is eroded and then difference is taken between original image and eroded image.

$$\beta(A) = A - (A \ominus B)$$