

Digital Image Processing

11 January 2007

Dr. ir. Aleksandra Pizurica

Prof. Dr. Ir. Wilfried Philips

Aleksandra.Pizurica @telin.UGent.be

Tel: 09/264.3415



Morphological filtering

Some illustrations taken from Ph.D. thesis of A. Ledda
Ghent University

Basics of mathematical morphology

The signals are locally compared with so-called **structuring elements** of arbitrary shape

The aim is to transform the signals into simpler ones by removing irrelevant information (e.g., holes, little pieces,...)

Morphological operations can be applied to binary and greylevel signals.

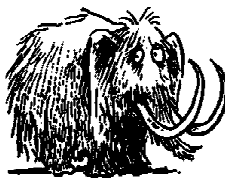
The most basic building blocks for many morphological operators are **erosion** and **dilation**.

06.b3

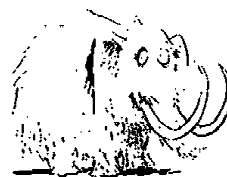
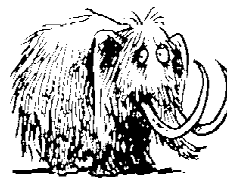
Mathematical morphology: illustrations

3 ingrediënten

- Image
- Operator
- Structuring element



- Dilation
- Erosion
- Closing
- Opening
- Gradient
- ...

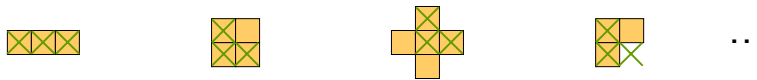


06.b4

Mathematical morphology: illustrations

3 components

- Image
- Operator
- Structuring element

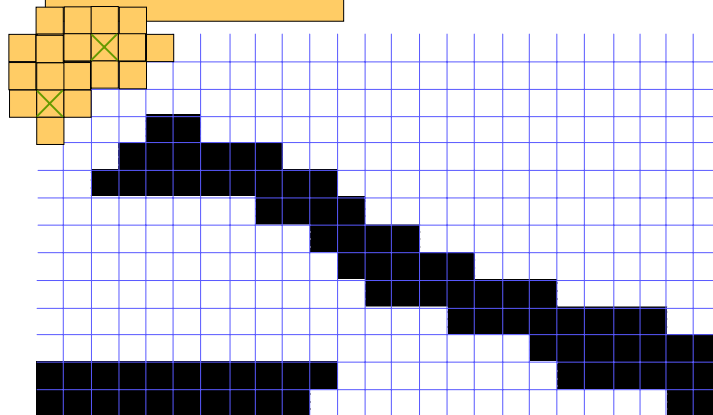


06.b5

Mathematical morphology: illustrations

3 components

- Image
- Operator
- Structuring element



06.b6

Erosion and dilation

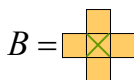
The **eroded image** of an object O with respect to a structuring element S with a reference point R , is the set of all reference points for which S is completely contained in O .

The **dilated image** of an object O with respect to a structuring element S with a reference point R , is the set of all reference points for which O and S have at least one common point.

06.b7

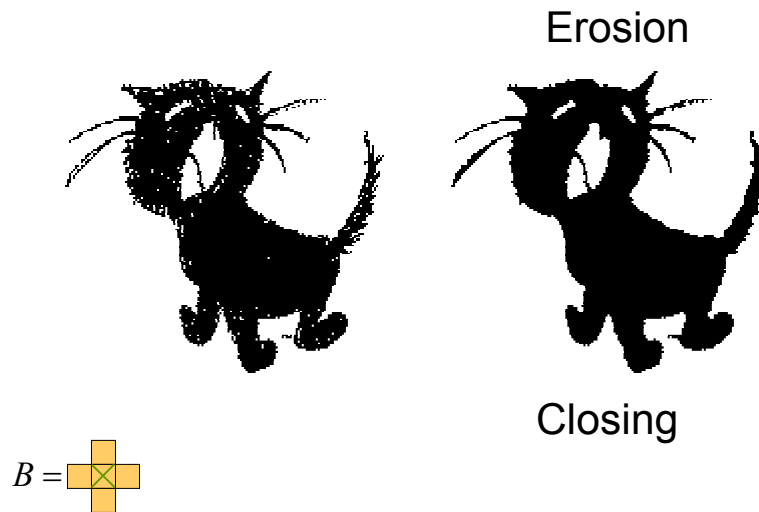
Operators

Dilation



06.b8

Operatoren



06.b9

Basic morphological operators

Dilation $\leftrightarrow$ Erosion

Closing $\leftrightarrow$ Opening

(erosion after dilation)

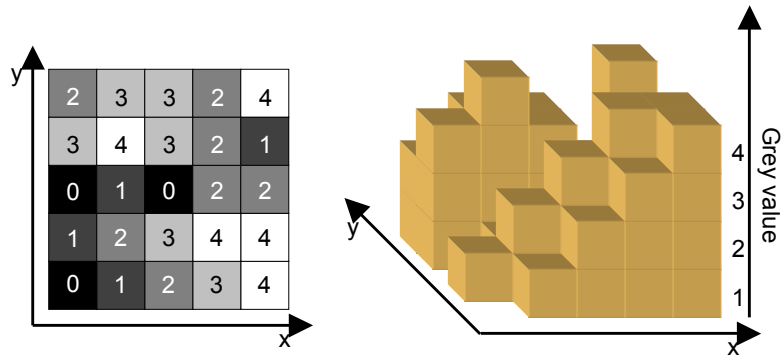
(dilation after erosion)

Other operators

- Gradient
- Thinning
- Thickening
- ...

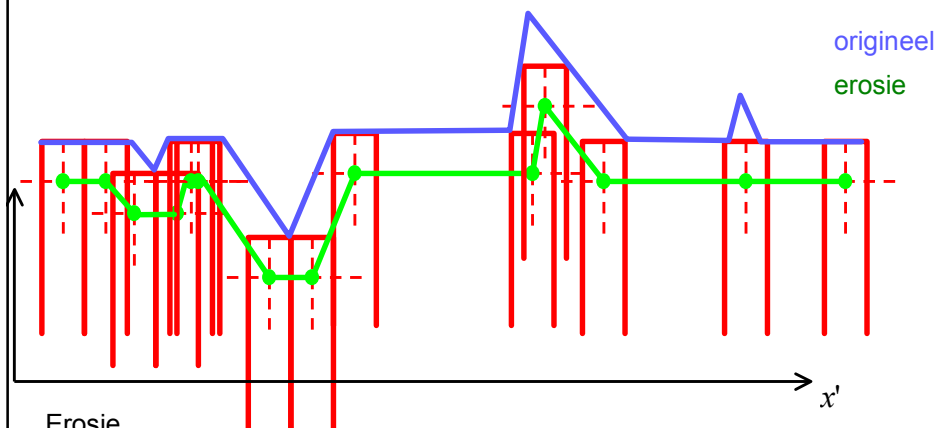
06.b10

Greyscale morphology



06.b11

Greyscale morphology: erosion

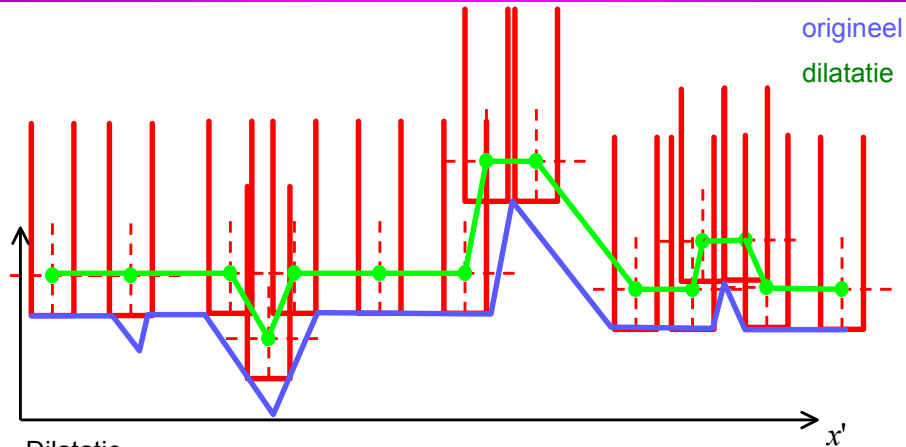


Erosie

- verwijdert smalle bergjes en maakt brede bergen smaller
 - maakt putten breder en minder scherp
 - verschuift het signaal globaal vertikaal (hier naar onder)
- Dit zouden we echter kunnen oplossen door bij ons structurelement een gepast getal op te tellen zodat $\max_{x'} h(x') = 0$

06.b12

Greyscale morphology: dilation



Dilatatie

- verwijdert smalle putjes en maakt brede putten smaller
- maakt bergen breder en stomper
- verschuift het signaal globaal vertikaal (hier naar boven), en dit even veel als erosie met hetzelfde structuurelement het naar beneden verschuift

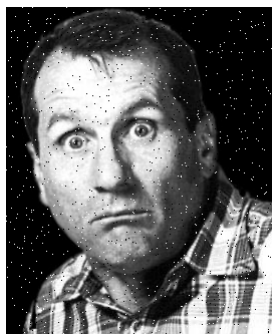
06.b13

Greyscale morphology

Example

Dilation

Erosion



Salt&pepper noise



Closing

Opening

06.b14