Grayscale Image Morphology

CMPUT 206: Introduction to Digital Image Processing

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Prepared with SDC Morphology Toolbox
Dilation and Erosion on Grayscale Images

• *I* is a grayscale image

• *B* is a structuring element

• Dilation is defined as

\[ J(i, j) = \max \{ I(x, y): (x+i, y+j) \text{ is in } B \} \]

• Erosion is defined as

\[ J(i, j) = \min \{ I(x, y): (x+i, y+j) \text{ is in } B \} \]
Dilation and Erosion

Grayscale image

Dilated image with a circular structuring element of radius 5 pixels

Eroded image with a circular structuring element of radius 3 pixels
Morphological Open

Open = first erode, then dilate

Original grayscale image

Open operation with a large circular structuring element
Morphological Close

Close = first dilate, then erode

Original image

Close operation with a circular structuring element of radius 3 pixels
Opening Top Hat

Opening top hat = subtract “opened” image from original

Original image

Opening top hat with a box structuring element
Closing Top Hat

Closing top hat = subtract original image from “closed” image

Original image

Closing top hat with a box shaped structuring element
Morphological Gradient

Morphological gradient = Dilated image – eroded image

How is the scale determined here?
Opening Top Hat: Detection of a Broken Cookie

Detect the broken cookie!

How? By eating the other.
Detection of Broken...

Opening top hat with a gigantic Hexagonal structuring element that fits in the unbroken cookie

Binarize: Apply threshold

Remove small connected components
Closing Top Hat: Defect Detection in a Microelectronic Circuit

A microelectronic circuit

We want to detect these defects.

How?
Defect Detection in a Microelectronic...

Close with a long and thick structuring element

Closing top hat
Defect Detection in a Microelectronic...

Threshold with 50

Discard connected components with areas 5 pixels or less

Overlay defects on original image