DSIP IA2

MORPHOLOGICAL OPERATIONS

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TY COMPS C

CONTENTS

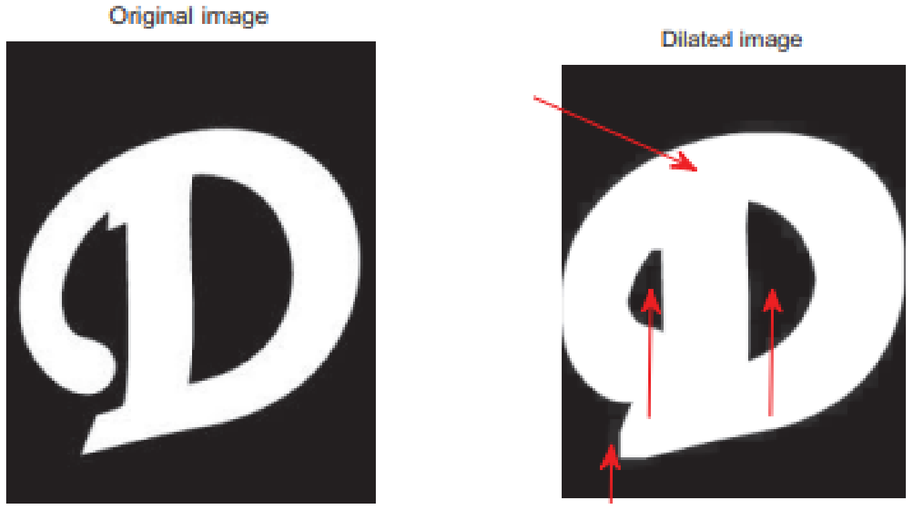
WHAT ARE MORPHOLOGICAL OPERATIONS?

- Morphological operations are simple to use and works on the basis of set theory.
- The objective of using morphological operations is to remove the imperfections in the structure of image.
- The operation uses a small matrix structure called as structuring element.
- The shape and size of the structuring element has significant impact on the final result.
- MATLAB software is used as the tool for experimenting the morphological operations.

DILATION

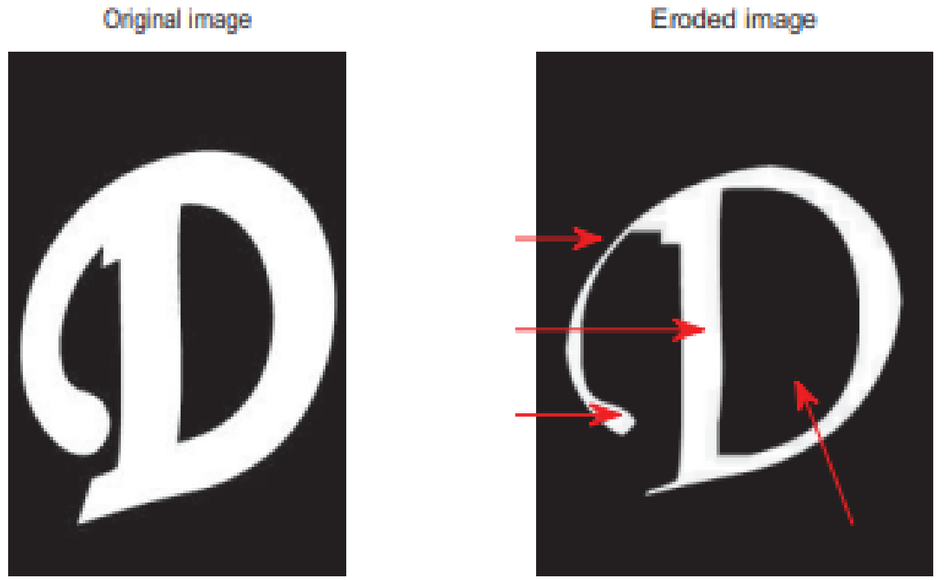
- It enlarges the boundary of objects in an image.
- It's achieved by adding pixels to the boundary, typically expanding foreground pixels (value 1) while shrinking background pixels (value 0).
- This process is useful for filling in holes and smoothing out the edges of objects.
- Dilation can be likened to applying a spatial low-pass filter, similar to blurring, as it affects the intensity at the boundary, resulting in a smoother appearance.

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



EROSION

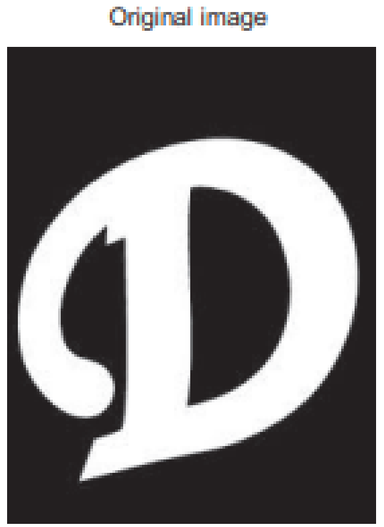
- It reduces the size of objects in an image.
- It works by removing boundary pixels based on a structuring element.
- This process enlarges background pixels (value 0) while shrinking foreground pixels (value 1).
- It is effective for removing small structures or noise, sharpening object boundaries by eliminating unwanted connections between objects.
- It can be likened to applying a sharpening high-pass filter in linear image filtering, as it enhances object edges and details.

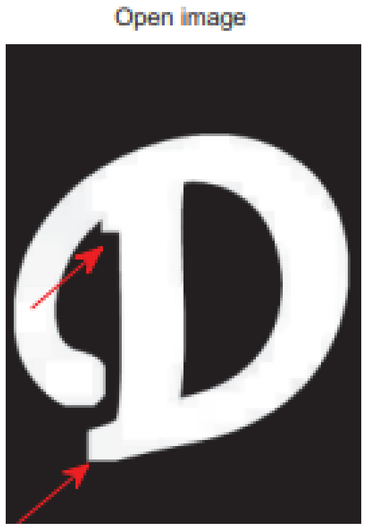


$$A \ominus B = \{z \mid (B)_z \subseteq A\}$$

OPENING

- It involves applying erosion followed by dilation with the same structuring element.
- It effectively smooths the outline of objects, clears narrow connections, and removes minor extensions.
- The boundary of the opened image corresponds to the points in the structuring element that reach the extreme points of the original object's boundary as the structuring element is moved inside it.
- This operation is useful for preprocessing images, particularly in tasks like object detection and segmentation.

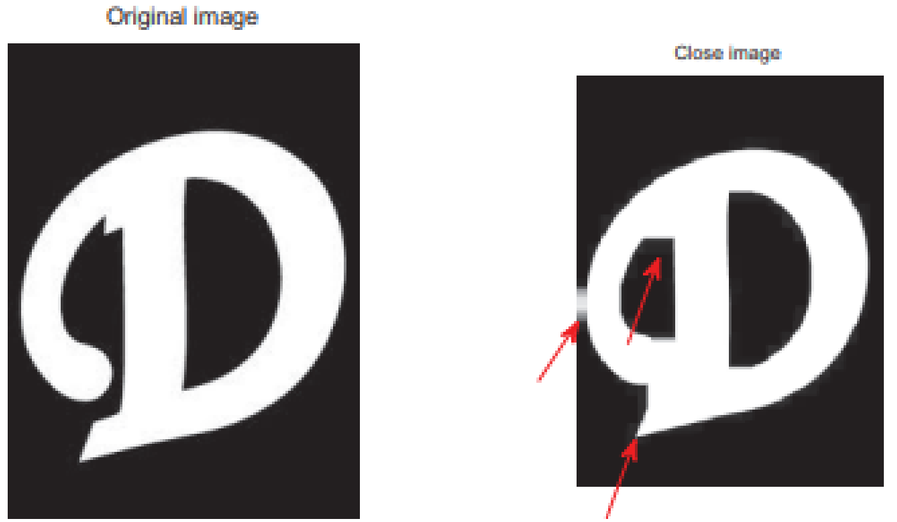




$$A \circ B = (A \ominus B) \oplus B$$

CLOSING

- It involves applying dilation followed by erosion with the same structuring element.
- Closing smoothens sections of contours and fills small holes or gaps in objects' boundaries.
- The boundary of the closed image corresponds to the points in the structuring element that reach the extreme points of the original object's boundary as the structuring element is moved around outside it.
- Closing is commonly used in image processing to improve object detection and segmentation by enhancing object connectivity and completeness.



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

HIT OR MISS TRANSFORMATION

- The hit-or-miss transform basically serves as a tool to identify and detect shapes in the image.
- The term hit refers to the exact match found in other sets apart from which the reference is taken.
- This transformation relies on the morphological erosion along with two disjoint structural elements.
- The first structural element ‘fits’ in the foreground on the considered image and the second structural element has to ‘miss’ it

$$A \otimes B = (A \ominus B_1) \cap (A^c \ominus B_2)$$

APPLICATIONS OF MORPHOLOGICAL OPERATIONS

01 - DILATE AN IMAGE TO ENLARGE A SHAPE

02- REMOVE THIN LINES USING EROSION

03- EXTRACT LARGE IMAGE FEATURES

04- FLOOD FILL OPERATIONS

05- FIND IMAGE PEAK AND VALLEYS

THANK YOU