

Morphological Operations for Image Processing

: Understanding and its Applications

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Abstract—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. Most of the operations used here are combination of two processes, dilation and erosion. 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. In this paper an attempt is made to understand the basic morphological operations by using them on some standard images. Matlab software is used as the tool for experimenting the morphological operations.

Index Terms— Morphological operation, Structuring Element, Dilation, Erosion, Opening, Closing, Boundary extraction.

I. INTRODUCTION

When images are processed for enhancement and while performing some operations like thresholding, more is the chance for distortion of the image due to noise. As a result, imperfections exist in the structure of the image. The primary goal of morphological operation is to remove this imperfection that mainly affects the shape and texture of images. It is obvious that morphological operations can be very useful in image segmentation as the process directly deals with 'shape extraction' in an image.

Morphology in context of image processing means description of shape and structure of the object in an image. Morphological operations work on the basis of set theory and rely more on relative ordering of the pixel instead on their numerical value. This characteristic makes them more useful for image processing. The input data for the mathematical morphological operations are two images: raw image and primitive image. Morphological operations are well defined for binary images but are equally valid and are found useful for gray scale images also.

Structuring element is a binary matrix of very small size. The structuring element is applied to interact with the image to get the resultant. The important characteristics to be considered for a structuring element are its shape, size and origin. Shape of the structuring element is the arrangement of ones and zeros in a pattern within the matrix. Size of the structuring element, acts as a 'window' over which the interaction takes place. It also helps to differentiate image objects or features. The origin of the structuring element identifies the pixel of interest that is to be processed. The mechanism of structuring element resembles that of masks used in spatial filtering, it is moved all around the image to be probed to find hit or miss at that location.

The paper is organized as follows; section II describes structuring elements in morphological operations, section III highlights some basic morphological operations, section IV

emphasizes on hit-or-miss transformation, section V gives applications of morphological operations and section VI discusses the result obtained on standard test images.

II. STRUCTURING ELEMENTS

Structuring elements are small sets in matrix form or a sub-image used to interact with the image to be probed. It helps us to define some arbitrary neighborhood structures. The precise details can be obtained by choosing suitable structuring element.

Usually the structuring element is represented as a rectangular matrix of odd dimension. Though the origin can be represented in the centre of matrix, it is not restricted to represent in the centre. It is observed in some structure elements, that the representation of origin is present outside the rectangular matrix. The binary structuring element is comprised of zeros and ones since all the elements have values. The ones define the neighborhood of the structuring element. The representation of structuring elements given below shows these arrangements (0s and 1s) it can be observed that in some representations only ones are shown but not zeros this is mainly because all the elements in the grid may not be active members of structuring element. So it is convenient that only ones are used. This is to avoid confusion and also it does not affect the operation since zeros are not considered. In some complicated structuring element representation, in addition to zeros and ones, 'don't care' conditions are also included. These are mostly used for thinning and pruning operations.

The interaction of the structuring element with probing image is such that the origin of the structuring element is translated to all possible pixel locations in the probe image and then the comparison is done between the image pixels and the structuring element. The result is then obtained based on the intended morphological process applied. Two dimensional structuring elements can be classified as flat structuring element and non-flat structural elements. Structuring elements in morphological image processing are same as convolution masks in linear image filtering.

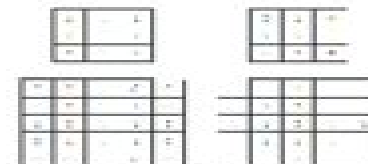


Fig.1 Representation of structuring elements

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Table of Contents Selected Papers On Morphological Image Processing

1. Understanding the eBook Selected Papers On Morphological Image Processing
 - The Rise of Digital Reading Selected Papers On Morphological Image Processing
 - Advantages of eBooks Over Traditional Books
2. Identifying Selected Papers On Morphological Image Processing
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Selected Papers On Morphological Image Processing
 - User-Friendly Interface
4. Exploring eBook Recommendations from Selected Papers On Morphological Image Processing
 - Personalized Recommendations
 - Selected Papers On Morphological Image Processing User Reviews and Ratings
 - Selected Papers On Morphological Image Processing and Bestseller Lists

5. Accessing Selected Papers On Morphological Image Processing Free and Paid eBooks
 - Selected Papers On Morphological Image Processing Public Domain eBooks
 - Selected Papers On Morphological Image Processing eBook Subscription Services
 - Selected Papers On Morphological Image Processing Budget-Friendly Options
6. Navigating Selected Papers On Morphological Image Processing eBook Formats
 - ePub, PDF, MOBI, and More
 - Selected Papers On Morphological Image Processing Compatibility with Devices
 - Selected Papers On Morphological Image Processing Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Selected Papers On Morphological Image Processing
 - Highlighting and Note-Taking Selected Papers On Morphological Image Processing
 - Interactive Elements Selected Papers On Morphological Image Processing
8. Staying Engaged with Selected Papers On Morphological Image Processing
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Selected Papers On Morphological Image Processing
9. Balancing eBooks and Physical Books Selected Papers On Morphological Image Processing
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Selected Papers On Morphological Image Processing
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Selected Papers On Morphological Image Processing
 - Setting Reading Goals Selected Papers On Morphological Image Processing
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Selected Papers On Morphological Image Processing
 - Fact-Checking eBook Content of Selected Papers On Morphological Image Processing
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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