LAB 10

Fall 2010, BESE- 13 & 14

Image Processing with MATLAB

Objective

Today's lab covers fundamental morphological operations such as dilation and erosion and using them in combination: opening and closing. By the end of this lab you should be able to perform morphological operations on an image in MATLAB and extracting image components that are useful in representing and describing shapes of a region such as boundaries, skeletons etc.

Instructions for LAB Report Submission

In this LAB (i.e. Lab-10) you are required to submit the lab assignment in a document (**.docx or .doc**) format. This document **MUST** include: *1)* piece of code (MATLAB script) you programmed to implement the assigned task, and *2)* snapshots of your work to show results.

Name your reports as: ***Lab#_Rank_YourFullName***

- '#' replaces the lab number
- '*Rank'* replaces Maj/Capt/TC/NC/PC
- '*YourFullName*' replaces your complete name.

Tasks for Today

1. Morphological Operations

The morphological image processing consists of a class of operations that are particularly used to fill out the incomplete regions of an object or a boundary, or removing certain unnecessary branches of an object or separating the connected regions.

A morphological operation is union (or intersection) of an image with translated shape (i.e. **structuring element**). So applying a morphological operation on an image is a 2 step procedure in MATLAB, defined below:

1. Create a Structuring Element using function **`sel = strel(shape, parameters)`**. The **table 1.1** gives a detailed overview of possible values for **`shape`** and **`parameters`** arguments.

2. Applying desired morphological operation (i.e. dilation, erosion etc) onto a read image using **`imdilate(image, sel)`** and/or **`imerode(image, sel)`** functions. Where **`sel`** is the structuring element created in step 1.

Syntax forms	Description
`se = strel('diamond', R)`	Creates a flat, diamond-shaped structuring element, where `R` specifies the distance from the structuring element origin to the extreme points of the diamond.
`se = strel('disk', R)`	Creates a flat, disk-shaped structuring element with radius `R`. (Additional parameters may be specified for the disk; see the `strel` help page for details.)
`se = strel('line', LEN, DEG)`	Creates a flat, linear structuring element, where `LEN` specifies the length, and `DEG` specifies the angle (in degrees) of the line, as measured in a counterclockwise direction from the horizontal axis.
`se = strel('octagon', R)`	Creates a flat, octagonal structuring element, where `R` specifies the distance from the structuring element origin to the sides of the octagon, as measured along the horizontal and vertical axes. `R` must be a nonnegative multiple of 3.
`se = strel('pair', OFFSET)`	Creates a flat structuring element containing two members. One member is located at the origin. The second member's location is specified by the vector `OFFSET`, which must be a two-element vector of integers.
`se = strel('periodicline', P, V)`	Creates a flat structuring element containing `2*P + 1` members. `V` is a two-element vector containing integer-valued row and column offsets. One structuring element member is located at the origin. The other members are located at `1*V`, `-1*V`, `2*V`, `-2*V`, `...`, `P*V`, and `-P*V`.
`se = strel('rectangle', MN)`	Creates a flat, rectangle-shaped structuring element, where `MN` specifies the size. `MN` must be a two-element vector of nonnegative integers. The first element of `MN` is the number rows in the structuring element; the second element is the number of columns.
`se = strel('square', W)`	Creates a square structuring element whose width is `W` pixels. `W` must be a nonnegative integer scalar.
`se = strel('arbitrary', NHOOD)` `se = strel(NHOOD)`	Creates a structuring element of arbitrary shape. NHOOD is a matrix of 0s and 1s that specifies the shape. The second, simpler syntax form shown performs the same operation.

Table 1: Syntax of strel function

NOTE: the input image for `imerode` or `imdilate` function must be binary.

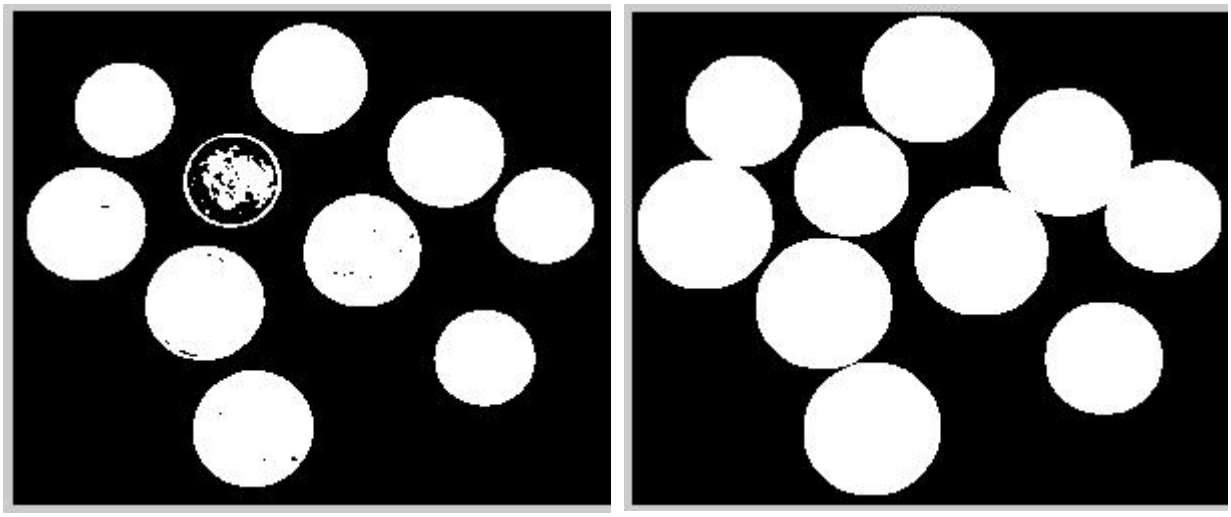
2. Dilation

Dilation grows or thickens objects. It expands the connected set of 1s in a binary image and thus is useful in growing features, filling holes, and gaps.

For instance, in MATLAB dilation with a disk of radius 5 can be performed as follows:

```
>> img = imread('coins.png');
>> imgb = im2bw(img);
>> sel = strel('disk', 5);
>> imgn = imdilate(imgb, sel);
```

The above lines of code will fill-in the gap left within the coins. But this will also result in connected boundaries of coins, as shown below:



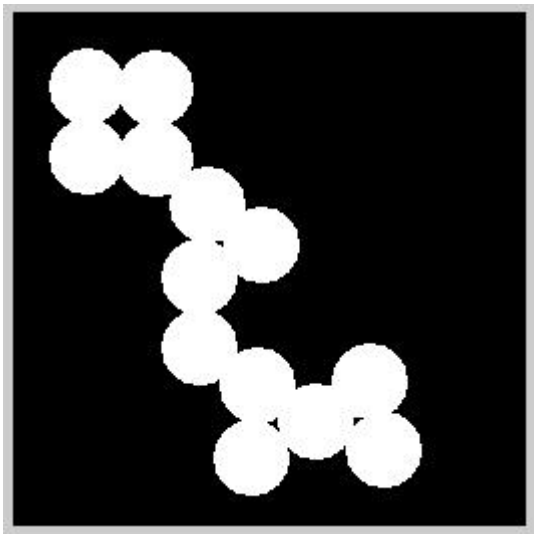
2. Erosion

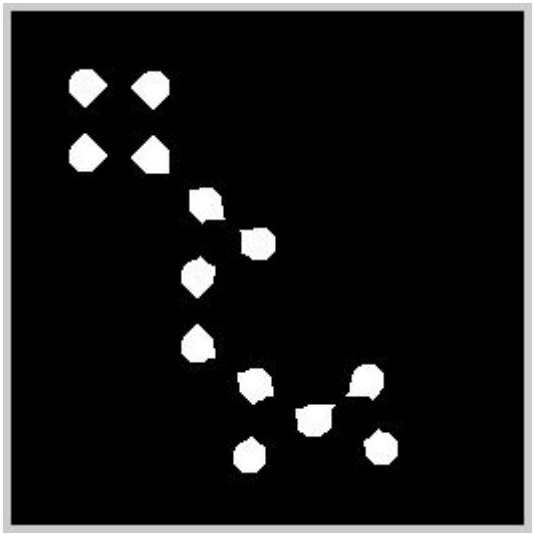
Erosion shrinks or thins objects in a binary image. It shrinks the connected set of 1s in a binary image and thus is useful in shrinking features, removing branches, and unnecessary boundaries.

For instance, in MATLAB erosion with a disk of radius 5 can be performed as follows:

```
>> img = imread('circles.png');
% since read image is binary so no need of conversion.
>> sel = strel('disk', 11);
>> imgn = imerode(img, sel);
```

The above lines of code will separate out connected circles, as shown below. Although, it shrunk the circles but this information can further be used in **`bwlabel`** function to find out total number or circles.



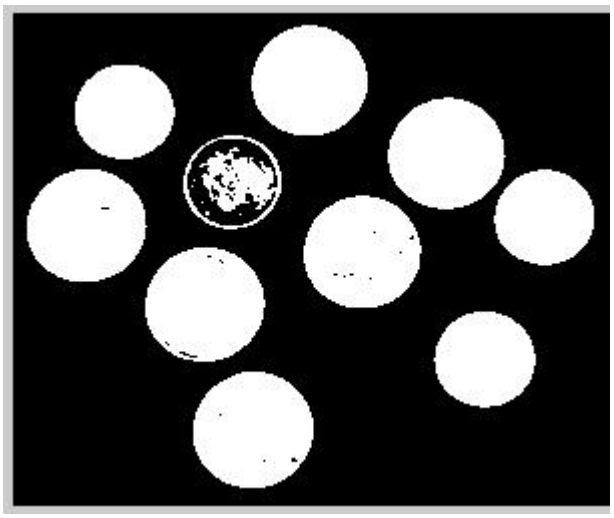


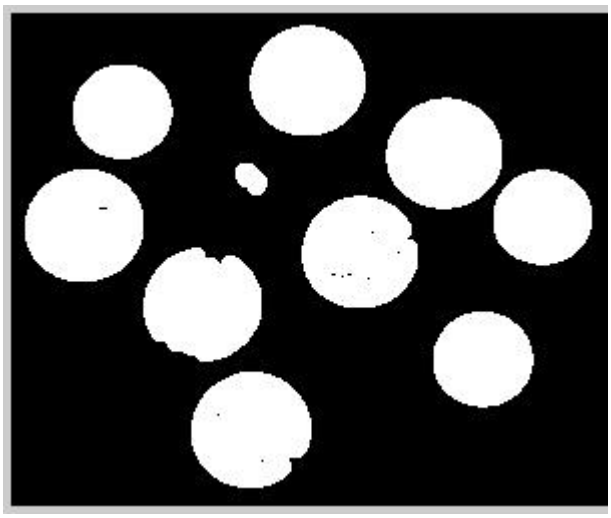
3. Combining Erosion and Dilation: Opening and Closing

In practical, morphological operations are performed as a series of erosion and/or dilation operations using the same, or sometimes different, structuring elements. Such an operation is called compound operation and is named as opening (*erosion followed the dilation*) or closing (*dilation followed by an erosion*).

For instance, in MATLAB **opening** operation with a disk of radius 5 can be performed as follows:

```
>> img = imread('coins.png');
>> sel = strel('disk', 5);
>> imgn = imopen(im2bw(img), sel);
```





Similarly closing operation can be performed using **`imclose`** function.

Exercise 1:

Read an image 'eight.tif'. Write a function named 'myMorphology' to extract the boundaries of coins from the read image.

[HINT]:

1. **A dilation followed by two erosions can be helpful.**
2. **Disk is suitable structuring element in this case.**