

# IN 5520

## Mathematical morphology

During this week's lecture we went through different algorithms for image processing based on mathematical morphology.

G&W DIP3Ed:      G&W DIP4Ed:

**Exercise 1.** Problem 9.6              Problem 9.9

**Exercise 2.** Problem 9.17            Problem 9.23

### Exercise 3

This exercise aims to provide the necessary knowledge in order to work effectively with morphological operations in Matlab. First, take a look at the help pages in Matlab and search for morphology and get a list of all available morphology Matlab operations.

In the following exercises we will use the image `circles.png` as example image. `BW = imread('circles.png');` Take a look at it with `imshow(BW);`

#### Image boundary

Find the boundary of the circles by using the function `imerode`. Then you first have to design a structure element by using `strel`. Make two structure elements, the first should be a disk with radius 1 and the second with radius 4. What is the result of using the different structure elements?

#### Image skeleton

Then find the skeleton of the image `BW` by using `bwmorph`.

The resulting image is noisy and not what we want, how can we improve it using `bwmorph`?  
Hint: use a function iteratively.

#### Finding image patterns by hit-and-miss

Generate an image by: `I = checkerboard(10,10,10); I=abs((I<1)-1);` and take a look at it.

`bwhitmiss(BW1,INTERVAL)` performs the hit-and-miss operation defined in terms of a single array, called an interval of the image `BW1`. An interval is an array whose elements can contain 1, 0, or -1. The 1-valued elements make up the domain of `SE1`, the -1-valued elements make up the domain of `SE2`, and the 0-valued elements are ignored.

The syntax `bwhitmiss(INTERVAL)` is equivalent to `bwhitmiss(BW1,INTERVAL == 1, INTERVAL == -1)`.

Make the matrix *interval* by:

```
interval = [0 -1 -1 1 1 -1 0 1 0];
```

Answer this question before you test it: Which structure do you detect by performing a hit and miss with this interval on the image I?

Did it match?

What happens in the middle of the chessboard pattern?

How should the interval be designed in order to detect all the wanted patterns?

#### **Exercise 4.**

In inspection of electronic circuit cards there is a need to inspect the number of holes and the diameter of the holes, see figure below. We want to measure the number of holes and the diameter using morphology. Use the morphology operators in Matlab to solve the exercise.

Use the image pcb.jpg

Tip: One solution is to use the Matlab functions *imfill* and *regionprops*.



Electronic circuit image.

#### **Exercise 5.**

Experiment with using either top hat or bottom hat as preprocessing before applying global thresholding to the image *morf\_test.png*. The images contain letters on a very noisy background with varying illumination.

Try to estimate a good estimate of the background, and subtract the estimated background from the original. Then try to use global thresholding on the resulting image. Do you also need a noise filter? Can you segment out the numbers fairly well?

Also consider if there are gaps or connected symbols that you can improve by applying simple binary morphology operations.