Image Analysis and Object Recognition

Exercise Sessions

Summer Semester 2025

(Course materials for internal use only!)

Computer Vision in Engineering – Prof. Dr. Rodehorst

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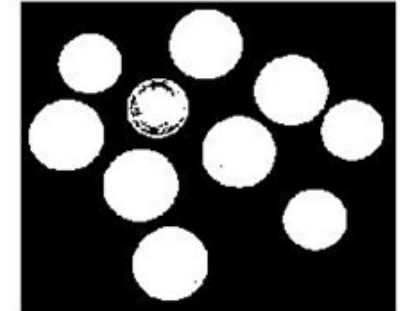mariya.kaisheva@uni-weimar.de

Assignment 1

Assignment 1: Overview

Topics:

- Image enhancement
- Thresholding (binarization)
- Morphological operators

Goal:

- Extracting image pixels representing foreground objects

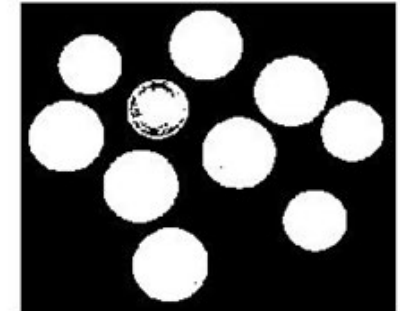# Assignment 1: Overview

Topics:

- Image enhancement
- Thresholding (binarization)
- Morphological operators

Goal:

- Extracting image pixels representing foreground objects

Keep in mind:

- This is only a simple method for foreground-background separation.
- Do not expect perfect results!
- Select images with relatively simple content!

Assignment 1: Overview

Input:

- A **starting input image** can be found on Moodle
- In this satellite image, the **water regions** should be treated as **foreground**
- For any additional test images:
  - o select a **low-contrast** photograph
  - o avoid too complex content
  - o decide in advance what should be foreground

Provided low-contrast input image

Tasks:

- **1**: Enhance image with bad contrast
- **2**: Find and apply a threshold on image values
  → separate background=**0** and foreground=**1**
- **3**: Refine the binary mask using morphological operators
- **4**: Write a main function, which conducts tasks 1 to 3.
  Evaluate the results and test your program with new input data.

Assignment 1: Task 1

Image Enhancement:

Note: Your input image may consist of multiple channels (r,g,b). Therefore, compute **mean** value for each pixel and **use the resulting grayscale image**.

a. Visualize the initial image and the corresponding histogram
b. Shortly describe the characteristics of the histogram
c. Enhance the image using *contrast stretching*
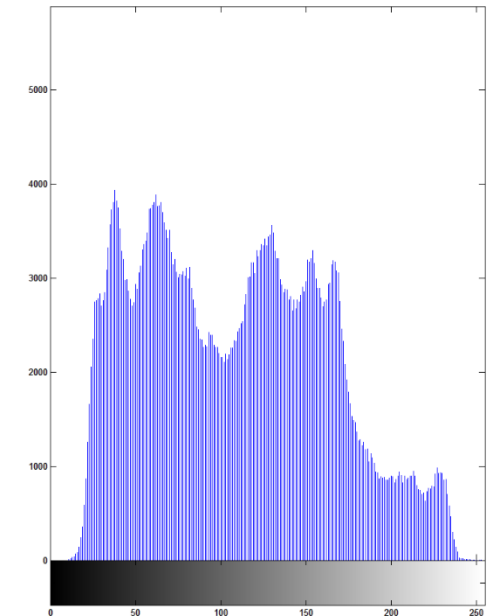d. Shortly describe the differences to the initial histogram
e. Visualize the resulting enhanced image

8-bit Image

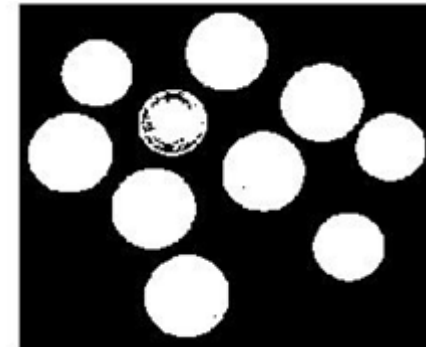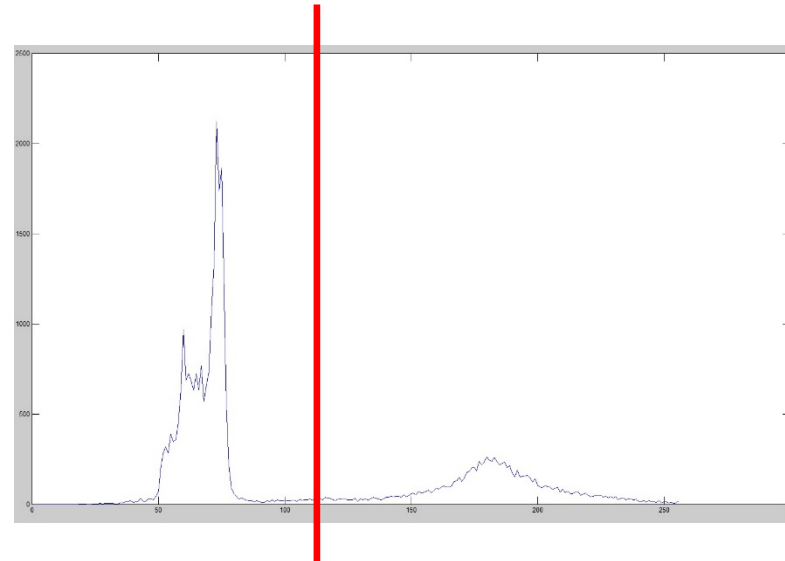
$$2^8 = 256$$

possible grayscale values

Gray value histogram

Thresholding:

a. Convert the enhanced image to a binary mask, where 0 = background and 1 = regions of interest
b. Visualize the resulting binary mask
c. Make some tests with different threshold values, and describe the difficulties you have in finding an appropriate threshold
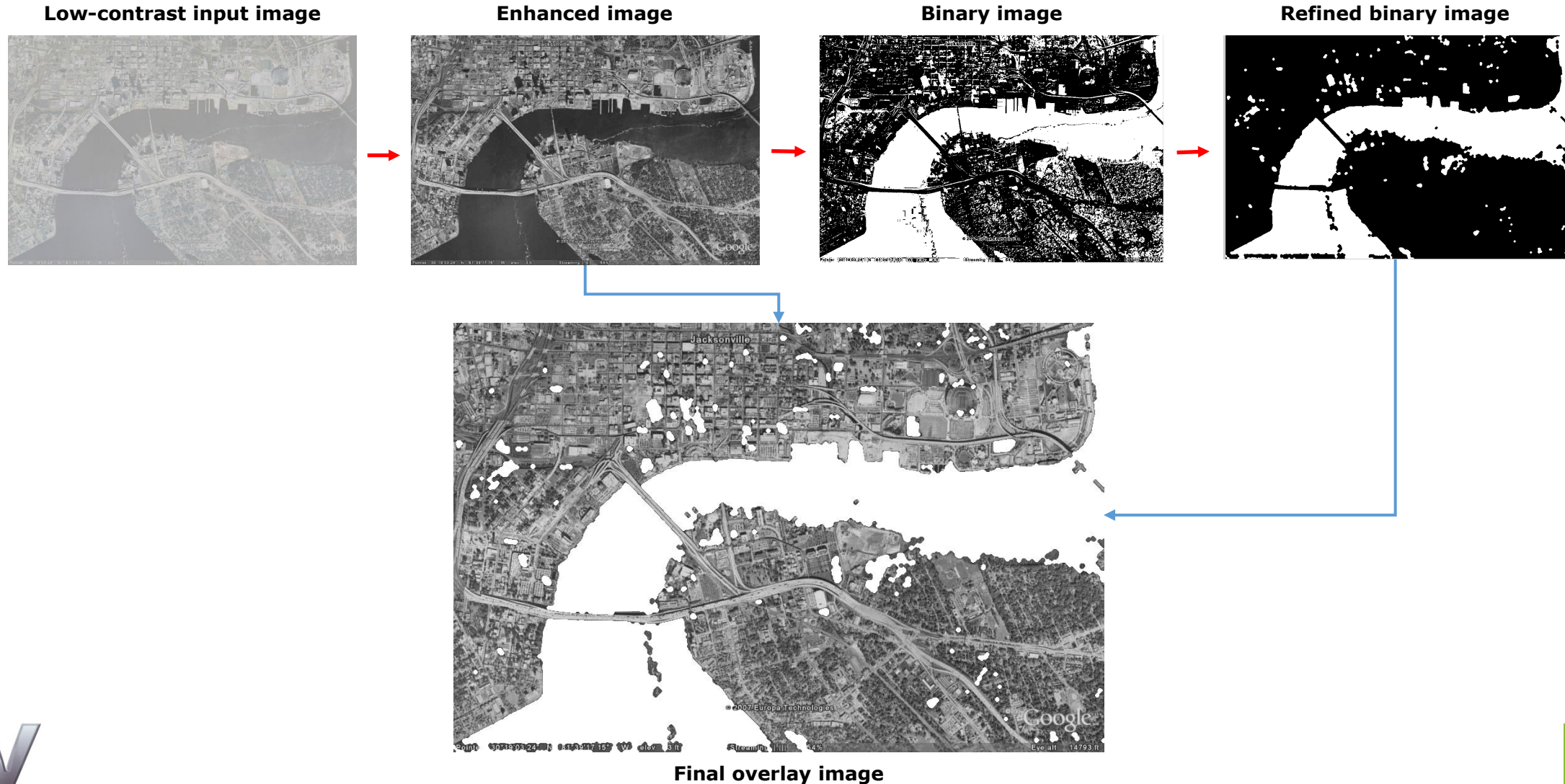
Morphological filtering:

a. **Successively** apply **opening** and **closing** on the input image

opening + closing

closing + opening
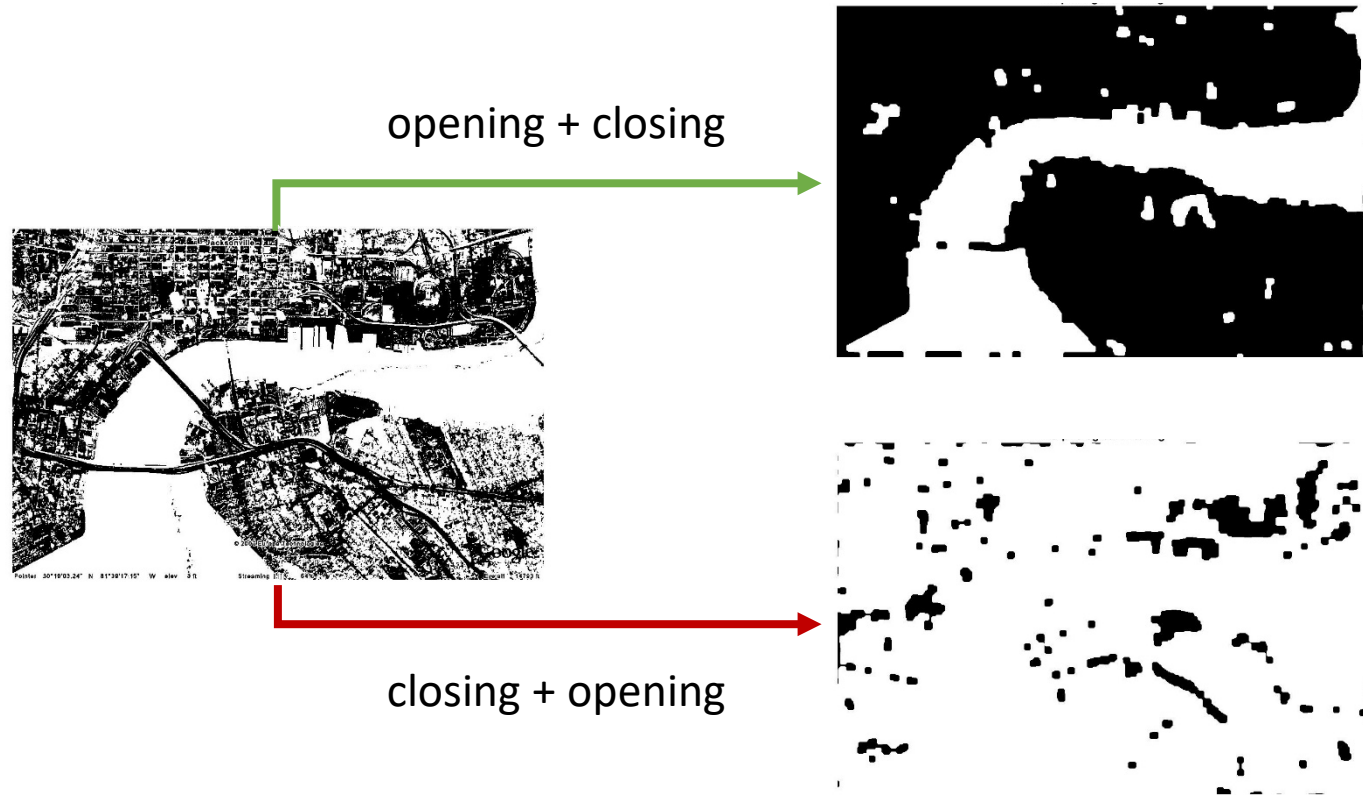
b. **Visualize** the resulting binary mask
→ function `imshow` available
in the `matplotlib` module

Assignment 1: Summary

Low-contrast input image → **Enhanced image** → **Binary image** → **Refined binary image**
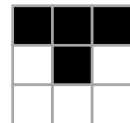
Final overlay image

Quick Question on…
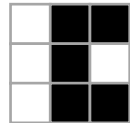
Morphological Operators

What is the binary image produced after applying the following operations on the given input image of size 12 x 12 pixels?

Each operation should be performed with the structuring element (SE) indicated next to it.
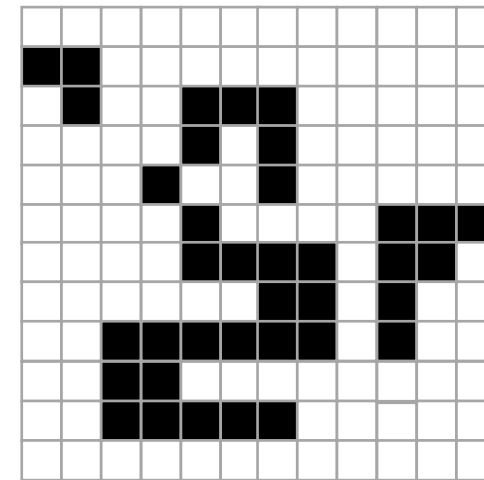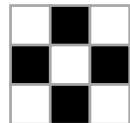
A. Erosion with SE

B. Opening with SE

C. Dilation with SE

binary input image