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Assignment 1

Image Enhancement, Binarization, and Morphological Operators

Submission Deadline: 26.04.2022, 11 pm

The city of Jacksonville needs your help. Based on a satellite image (`input_sat_image.jpg`) of low contrast, you are supposed to extract the water surfaces in the city area. That is, water surfaces are to be treated as the foreground, while all other surfaces represent the background of the image.

Task 1 – Image Enhancement

Implement a function to enhance the contrast of an image. For that purpose, convert your color image into a grayscale image (`imread`, `mean`, `rgb2gray`, ...).

a) Visualize the initial image and the corresponding histogram (`figure`, `imshow`, `imhist`...).
b) Shortly describe the characteristics of the histogram.
c) Enhance the image using contrast stretching (**self-written code**; built-in `min`, `max` are allowed).
d) Shortly describe the differences compared to the initial histogram.
e) Visualize the resulting enhanced image.

Task 2 – Binarization

Implement a function for thresholding the enhanced image of Task 1.

a) Convert the enhanced image to a binary mask, where 0 represents **background** and 1 represents **foreground**, i.e. water surfaces.
b) Visualize the resulting binary mask.
c) Test a number of different threshold values and describe the effects. What difficulties did you encounter finding an appropriate threshold?

Task 3 – Morphological Operators

Use morphological filtering on the mask obtained from Task 2.

a) Successively apply morphological opening and closing on the mask (`imopen`, `imclose`).
b) Visualize an overlay of the enhanced image from Task 1 and the morphologically filtered mask.
c) Write a main function which sequentially executes the functions from Task 1 to 3.
d) Are the results satisfactory? What are the limitations of this approach for foreground-background separation?
e) Test your main function with a different input image of your choice. Do you notice a significant difference for the chosen input image?

Submit your source code, the resulting images, and a `.pdf` (or `.ipynb`) file containing your answers.

Sample Results:

Input Enhanced Binarized Filtered Overlay