Medical Image Computing

(MT-M-3-ILV-IM2)

Exercise 01

Start Date: 18.10.2023

Due Date: 1.11.2023

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1. General information

1.1. Report submission: Please add all authors of your group to the report **(group size to be between 2 and 3).** Each author has to upload the full submission (report+code). The report must be attached in PDF form.

1.2. Code submission: Please add a single compressed package containing all relevant code and data.

1.3. All relevant information can be found in the Sakai Course Site: https://sakai.mci4me.at/portal/site/Course-ID-SLVA-41904

1.4. In case of any questions please use the Sakai Forum, or e-mail to: marco.augustin@mci4me.at

1.5. Image data to use in the exercise is attached to the exercise specification in Sakai.

2. OCT image preprocessing framework (2.5 points)

2.1. Load the OCT image ("OCTimage_raw.tif") and investigate the image by analyzing the histogram. Show the histogram and discuss it.

2.2. Define an intensity transformation to enhance the contrast. Which transformation did you choose and why? Show the transformed image.

2.3. Take a spatial filter of your choice and try to denoise the image. Which filter (and parameters) did you choose? **Normalize the filtered image to the range of [0, 1] and use the filtered image for all subsequent steps.** Show the filtered image. What were the effects?

2.4. Select three pixels and analyze the 21 x 21 neighborhood: calculate the mean and standard deviation values for the three regions. Plot the histograms of the regions. What were the coordinates of the pixels? What are the characteristics of your selected regions?

2.5. Define a threshold T and try to split the image into retina and vitreous. Which value did you pick and why?

3. Edge detection (2.5 points)

3.1. Use the Sobel kernel to find the horizontal and vertical edges in the OCT image. Show the filtered images and describe them.

3.2. Calculate the image gradient based on the horizontal and vertical edges and show the gradient magnitude image.

3.3. Specify a threshold on the gradient magnitude image and try to segment the most prominent boundaries in the image. What was the level of the threshold?

3.4. **(BONUS + 1 point)** Use the canny edge detection to perform the same task and show the result. Discuss the choice of parameters for the canny edge detection.

4. Image segmentation (2 points)

4.1. Use the Otsu thresholding algorithm to segment the image into retina and vitreous. What was the threshold found by the algorithm?

4.2. **(BONUS + 1 point)** Choose one additional segmentation algorithm (you do not have to implement the algorithm by yourself) and perform the same task. Discuss the choice of the algorithm and the parameters you have used (try different).

4.3. Segmentation evaluation: Assume that the goal was to find the boundary between the vitreous and the retina/choroid. Which of your segmentation algorithms (2.5, 3.3, 4.1; If applicable also 3.4 and/or 4.2) performed best and give a rationale?