Zurich University
of Applied Sciences

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Digital Image Processing
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Lab 6 – Color Image Processing

This lab deals with the basics of color image processing. The following exercises focus on color coding and color segmentation.

Learning Objectives

- You know what color coding is.
- You know various strategies to apply color coding to gray scale images.
- You are familiar with the basics of color segmentation.
- You know what happens when you apply brightness adjustment and contrast enhancement algorithms to color images.

1 Color Coding

Color coding is a method to convert gray scale images into color images. It is a useful method to better understand and describe images, e.g., in the field of medical imaging or meteorology (pseudo-colors). The goal of this exercise is to convert different gray scale images (`bloodCells.tif`, `artery.tif` and `ctSkull.tif`) into color images using up to eight colors. There are various strategies for color coding. Here, we suggest the following

- The pairwise distance between colors (in color space) should be as large as possible. Figure 1 illustrates this idea.
- Each color should have the roughly the same frequency of occurrence. This means if the image has N pixels and we choose k colors then there should be roughly N/k pixels of each color.

1. Compute and plot the gray level histogram of the original image.
2. Choose the colors you want to apply to your gray scale image. Use an existing color map from, e.g., `matplotlib.colormaps` or define your own.
3. Based on the histogram determine which interval of gray levels is mapped to which color.

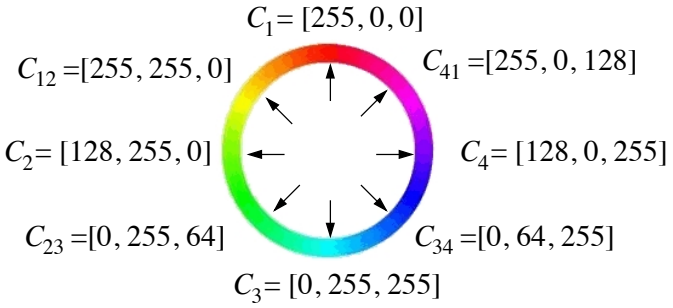

Figure 1: Color circle in RGB coordinates.

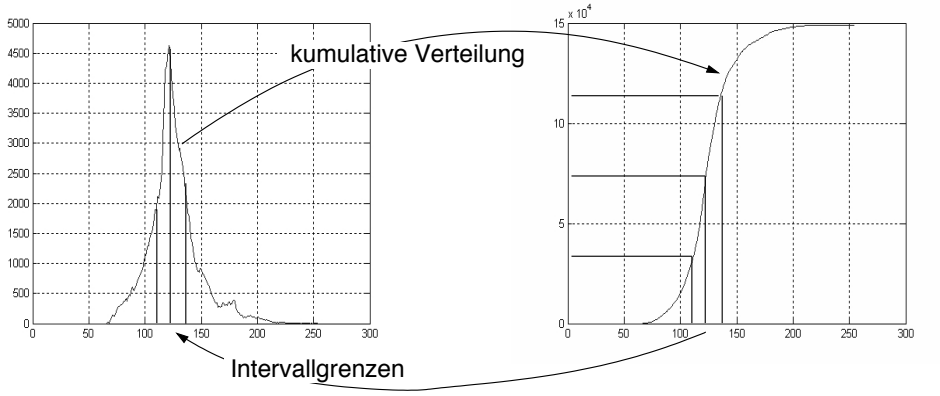

Figure 2: Gray level histogram with decision boundaries.

4. For each of the given gray scale images create a color coded image amd display it.

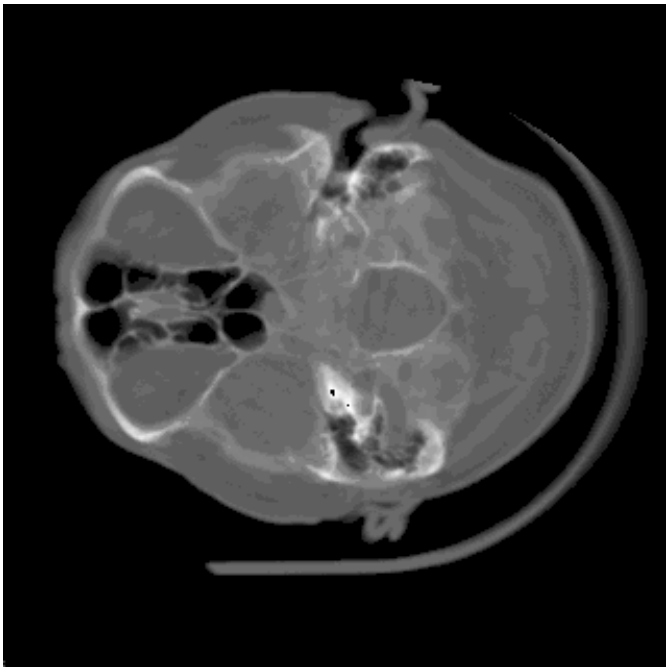

Figure 3: Gray scale CT scan.

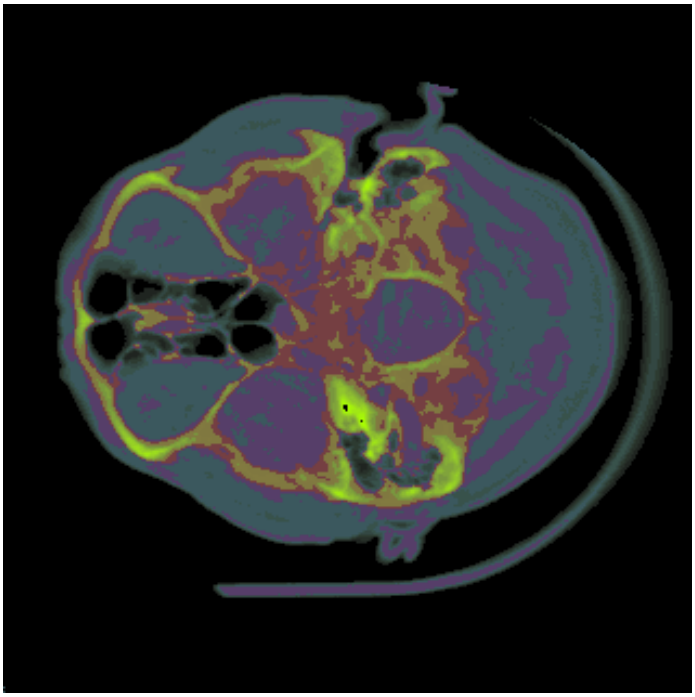

Figure 4: Color coded CT scan (with additional intensity information).

2 Color Segmentation

This exercise aims at selecting all image regions featuring a certain color. In our example, we have a color coded image that shows various brain cells (blue). We want to extract (and count) all brain cells visible in the image.

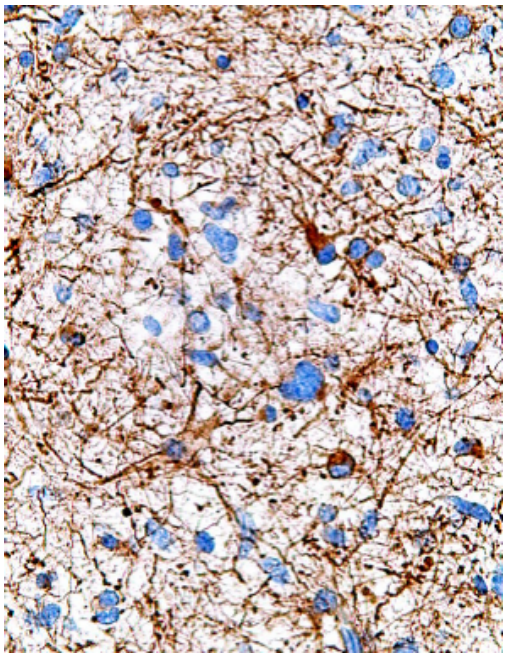

Figure 5: Color coded brain cell image.

(a) Convert the image to different color spaces: RGB, CMY, and HSI. For each color space display all three channels as gray scale images.

(b) Based on the above findings choose the color space that is most suitable for the segmentation task.

(c) Carry out the color segmentation. **Hint:** As you do not want to select a single color but a color range you can define an upper and lower threshold for each of the three channels.

(d) Display the segmentation result as BW image.

(e) Optional: Automatically count the number of brain cells (hint: morphological image processing).

3 Brightness Adjustment and Contrast Enhancement

Here, we will be looking at different strategies how to adjust the brightness and contrast of color images. Starting point is the image `landscape_1.jpg`.

Figure 6: Starting point for brightness and contrast adjustment.

(a) Load the RGB `landscape_1.jpg` image.

(b) Adjust the image's brightness by applying the same γ-correction to each of the three color channels.

(c) Compare the image before and after the correction.

(d) What happens if you apply the γ-correction to only one single channel?

(e) Try to increase the image contrast by applying histogram equalization to each of the three layers.

(f) Compare the images before and after histogram equalization. Can you comment on how individual colors behave?

(g) Do you obtain better results if you convert the image into HSV color space?