

DIP Assignment 1

SSE@TJU, Fall 2020

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Li Hua is a pulmonologist at Tongji Hospital and has been fighting the COVID-19. Since CT is one of the most common detection methods for COVID-19, Li Hua and his department have to check a huge number of CT images every day. However, Li Hua has run into some troubles recently. Please help him solve the problems and fight the COVID-19 together.

1 Problem 1: CT contrast enhancement

Because of the huge workload, the hospital's CT machines have malfunctioned, resulting in unclear CT images, which seriously affects the accuracy and efficiency of diagnosis. The contrast between normal and unclear CT images are shown in figure 1. The CT machine cannot be repaired immediately, but there are still many patients waiting for diagnosis.

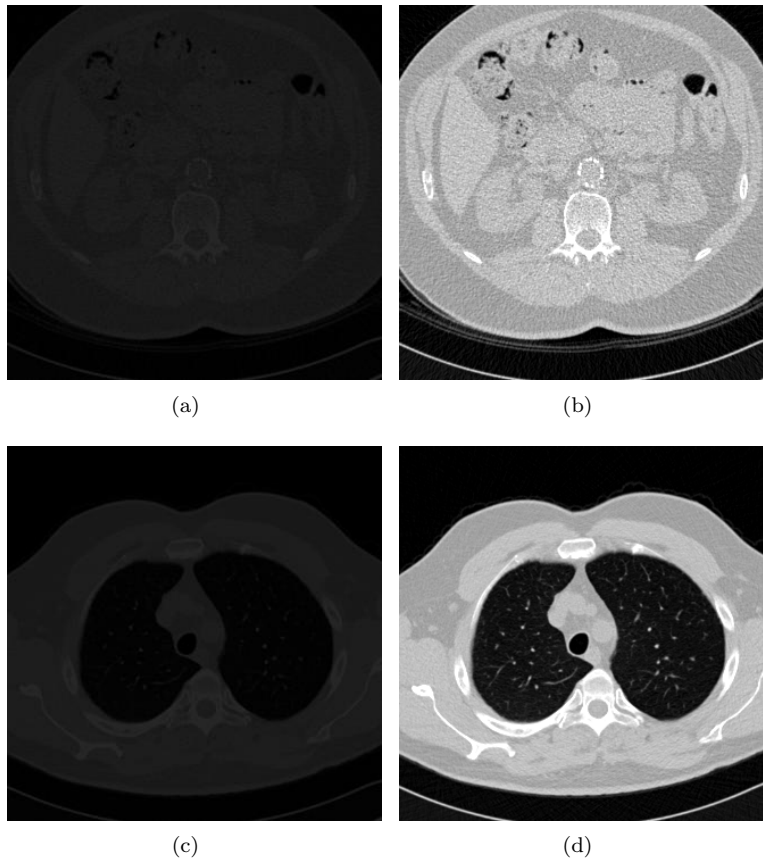


Figure 1: Contrast between normal and unclear CT images

To assist Li Hua, we can perform contrast enhancement on images captured by the CT machine and

display the enhanced CT images to doctors. For each image in the folder `data1`, please perform the following operations and submit the required results.

(a) Calculate and plot the histogram of original images and briefly comment on the shape of the histograms.

(b) Apply global histogram equalization to original images. Submit the modified images. Check the histogram of the modified images grayscale values and comment on visually desirable/undesirable regions in the modified image.

(c) Apply locally adaptive histogram equalization to original images. Submit the modified images. Check the histogram of the modified images grayscale values. Choose and report the number of tiles and the clipping limit for attaining higher contrast while avoiding the generation of noisy regions and the amplification of nonuniform lighting effects. Describe the subjective quality of the modified image compared to the result in (b).

(d) Apply a γ -nonlinearity mapping to each image to perform contrast enhancement. Submit the modified images. For each image, find and report a value of γ that allows you to see more details.

2 Problem 2: Resizing X-ray images

In order to further improve the efficiency of diagnosis, the Network and Machine Intelligence Laboratory of school of software engineering helps Tongji Hospital to develop an automatic diagnosis system based on deep learning technology. Because of the mistake in specification identification (requirements engineering is really important), the hospital can only provide X-ray images of size 256×256 , but the automatic detection system can only accept input of 1024×1024 . Please help Li Hua resize the X-ray images in folder `data2` to make the system work properly.

(a) Apply the nearest neighboring interpolation methods to X-ray images. Submit the modified images. Check the images and comment on the desirable/undesirable regions in the modified image.

(b) Apply the bi-linear neighboring interpolation methods to X-ray images. Submit the modified images. Comment on the subjective quality of the modified image compared to the result in (a).

(c) Apply the bi-cubic neighboring interpolation methods to X-ray images. Submit the modified images. Compare the modified images to the result problem (a) and (b).

Note: all algorithms should be implemented by yourself in MATLAB. MATLAB functions like 'histeq' are not allowed but it's highly recommended that you compare the result of your own implementations with these MATLAB functions. Use latex to prepare your report and the report should be submitted in pdf format. Don't forget to include the modified images of each problem and your MATLAB code in your submission. The report should be no more than 10 pages.