Comp3402 Unit1 Contrast Enhancement

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Purpose	To develop an understanding of images and how to change their contrast to make them more useful to the viewer.
Files Required	Octave scripts in the zipped folder "Octave_ImProc_Release" on the module site.
ILO Contribution	Position Paper 1 (part 1) Learning Outcome 2.
Send to Me	
Homework	

Activities

1 Initialisation

(a) Download the Octave Scripts and Images folder and unzip to a place of your choice. I usually use the Desktop.
(b) Copy the path to the folder Octave_ImProc_Release
(c) Open up Octave-GUI and in the Command Window type "cd" then space then right click and paste the path. Hit return
(d) Load the image processing package by typing "pkg load image".

2 Linear Contrast Stretch

Here you will perform an *interactive* contrast stretch where you will look at the largest and smallest grey-values in the input image and map these onto the maximum range for images of type "double" (0.0 – 1.0);

(a) Open the Script "ContrastStretchLinear" in the Octave Editor. Read through the script so you see what's going on. There's lots of annotations.
(b) Make sure the image "LungCancer4a.jpg" is selected in **imread(…)**.
(c) Type "ContrastStretchLinear" in Octave's Command Window.
(d) Look at the image displayed. Can you see any cancer nodules (small round things) ?
(d) Now let's stretch the contrast to try to make these more visible:
   Look at the histogram:
   (i) estimate the lowest and highest grey value in the original image
   (ii) type these in when Octave asks you
   (iv) type in 0 and 1 for the low and high values for the contrast enhanced output image
(e) Check the output image and its histogram
   (i) Does the histogram show that the contrast has been stretched?
   (ii) Is there an improvement in the contrast in the image?
   (iii) Can you identify nodules now? Has contrast enhancement helped you to make a diagnosis?
(f) Make sure you understand the process of contrast enhancement – how the code works and how this is reflected in the images and their histograms. Perhaps make some notes and copy images and histograms into a document.
(g) Now try out with some other images. I suggest "lena.jpg" and "cameraman.tif" which are

both *standard reference* image processing images.

3   Automatic Linear Contrast Stretch

Here the contrast stretch is automatic. The largest and smallest grey-values are selected automatically via a call to **stretchlim(…).** To do this it looks at the actual histogram values in the original image. The lower limit is taken at 1% above the lowest value, and the higher limit is taken 1% below the highest values. You can change these values.

(a) Open un the script "ContrastStretchLinearAuto" and understand what is going on.
(b) Type "help stretchlim" in the Command Window. This will explain what this function is doing. You can also consult the link to the MATLAB reference on the module web pages.
(c) Make sure the input image is "LungCancer4a.jpg" and run the script
(d) Look at both input and output images and their histograms. Has contrast stretching worked well?
(e) Experiment with other images.
(f) Try changing the TOL range in the **stretchlim(…)** function, currently set to [0.01,0.99] which is a 1% level. Perhaps try 5% or 10%. Can you see any improvement or reduction in performance?

4   Histogram Equalization

As explained in class, Histogram Equalization tries to do more than just stretch the contrast. It tries to change pixel values, so all pixels have equal probabilities of occurrence in the transformed image. In theory, this should maximize the communication of information from the image to the viewer.

(a) Open up the script "HistEqualization" and check out the code. There's not a lot to see here since the function **histeq(…)** does all the work for us.

(b) Run the script. Look at input and output images.
   (i) Can you see evidence of contrast stretch?
   (ii) Can you see evidence of equalization?

(c) Compare this transformation with contrast stretching. Can you see any differences?

(d) Experiment with other images.

(e) Which do you think is a better enhancement algorithm? Perhaps this depends on the image being processed?

5   Histogram Equalization of color images [OPTIONAL]

First let's see how not to run the transformation on a color image, then how to do it properly. First close down any figures showing from a previous transformation.

(a) The script "HistEqualizationColorBad" takes an RGB image and equalizes each channel separately, then combines the equalized channels into a final output image. Open up the

script and check that you understand how it works.

(b) Run the script. You should see the output image is indeed enhanced, however the hue (color) content has been changed. Not good. Try with other images.

(c) Now open up the script "HistEqualizationColor" which converts the RBG image into HSV. Here the luminance information is contained in the V-channel, and the equalization is applied to this channel, leaving the H-channel (hue – color) and S-channel (saturation) alone. Make sure you understand how this works.

(d) Run the script and check it performs well on the color images, comparing with the Bad approach. Try other images if you like.