Digital Image Processing in Astronomy

Please write your results in a textfile or m-file and send it to me by e-mail at the latest on 12/05/2014. Group work is permitted but text and programs should be written by yourself.

Exercise 1: *Polar coordinates [1.5 Points]*

(a) Write a function that returns the distance between two points in a flat surface. The position of the points has to be in polar coordinates. (Hint: Sketch)

(b) Calculate the distance between the points A$(3, \frac{\pi}{8})$ and B$(7, \frac{3\pi}{4})$ using the above function.

Exercise 2: *Calculating the sum with MATLAB [1.5 Points]*

Show using MATLAB that the sum $\sum_{n=0}^{\infty} \frac{(-1)^n}{2n+1}$ converges. Calculate the sum for the following values of n and plot the sums.

(a) $n = 100$

(b) $n = 10,000$

(c) $n = 1,000,000$

Exercise 3: *Picture puzzles (Suchbildratsel) [3 Points]*

Search and select a picture puzzle from the internet[1]

(a) What is a connected component and what is the condition to call it a connected set. Give examples.

(b) Find graphically the differences in the pictures.

(c) Now create a function that reads two arbitrary image, finds the differences, and outputs the number of differences.

Exercise 4: *Gamma correction [4 Points]*

Pick out a high-contrast gray scale image or convert a colour image and do the following steps:

(a) Create a histogram. Write briefly about histogram and its various types of plotting?

(b) Perform histogram equalization and compare it with the original histogram. Calculate and plot the transformation function.

(c) Perform a contrast enhancement with a large fraction of pixels in the lower and upper saturation region.

(d) Apply a gamma correction with $\gamma = 0.5$ and $\gamma = 2.0$.

[1] For example: http://www.kids4quiz.de/master.php?kat=149

(e) Convert your image into a binary image so that approximately the same number of black and white pixels are present before and after the gamma correction.

(f) Compare *imadjust*,*histeq* and *adapthisteq* enhancement techniques.

For questions or problems with the exercise, contact us at:

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