

RRY025-- Image Processing

Collection of random recent exam questions

[2 p] Is a mean filter good in removing saturated pixels from an image? Explain your answer. 'Saturated' means that the value of the pixel is erroneously at the maximum value (256 for an 8-bit image).

[2 p] Explain with words what is the 'Convolution Theorem'. Why is it an important theorem in image processing?

[2 p] Explain with your own words what is the meaning/significance of the Shannon's coding theorem? What does it mean (or what does it tell you) if the image is coded so that the average bits/pixel value is lower than the value given by the theorem?

[3 p] Sketch (=draw) the Fourier transform of a tophat function. With the help of that sketch, explain why smoothing images with an ideal low-/high-/band-pass filter does not usually lead to the best possible result. What kind of filter would yield a better result and why?

[5 p] Demonstrate how the Huffman coding compresses an image. Follow the roadmap: Define yourself a suitable 4x4 or 5x5 pixel array (=image); generate the Huffman tree for the image; generate the Huffman dictionary. Finally, explain using compression ratio how efficient the Huffman compression for this image was?

[5 points] Consider an image that is 256 x 256 in size and has gray-level 150 in 10% of the pixels and gray-level 200 in 90% of the pixels.

The image is ordered so that all 150s come first, and all 200s come afterwards. In terms of Matlab arrays, this would mean that $\text{Image}(1: 0.1 \cdot \text{Npixels}) = 150$ and $\text{Image}(0.1 \cdot \text{Npixels} + 1 : \text{end}) = 200$, where Npixels is the total number of pixels in the image.

Design a run-length encoder that transmits a bitstream consisting of the image and all necessary data for the receiver to recreate the image. ('Bitstream' refers to a series of ones and zeros). How many bits does it need to transfer? Discuss the main benefits and drawbacks of this encoder.

[7 points] Describe a workflow using wavelet transform to separate (=identify, or to highlight) from an image objects that are aligned in a certain direction. The objects you would like to separate are 5-10 pixels wide in the dimension perpendicular to their alignment direction.

A concrete user case to help to visualise the task: Consider a fighting scene from a medieval tv series. There is a scene with arrows flying to a common direction. On the background of the arrows there is a relatively smooth, large-scale structure that is not interesting – for example clouds, or a bit unsharp forest. The director would like to better focus the attention to the arrows by manipulating the background. To do this, the arrows need to be identified in the images.

Describe the workflow with as much detail as possible, however, it is not necessary to present Matlab coding or pseudo-code. Drawing sketches can be very helpful. You can also refer to Matlab functions if you consider it necessary. Write down two possible pitfalls/problems/points of improvement for the method you have devised.