IMAGE PROCESSING (RRY025/ASM420)

One of the Exams in 2018/2019

1 Warming up: MISCELLANEA [12 points]

(a) [4p] Discuss and illustrate with examples the importance of Heisenberg uncertainty principle in digital image/signal processing.

(b) [4p] Discuss and illustrate with examples the importance of robust statistics in digital image/signal processing.

(c) [4p] The point spread function (PSF) has a talkative name. Why is it called so? How important is it to know the exact PSF in image restoration? If you don't know the PSF, then how can you estimate it? If the image has no distortions, then what are the PSF and the optical transfer function (OTF)?

2 MISCELLANEA [15 points]

(a) [9p] You have an image of size 1024×1024, whose central 256×256 block is of special importance. To highlight this block with respect to the rest of the image, you test the three methods listed below. For each method, first of all explain the basic idea behind your implementation [1p], and then describe your implementation in detail [2p].

- `Method 1`: High-boost the block, and smooth the rest of the image.
- `Method 2`: The previous method is not good if your original image is noisy, since the noise in the block gets amplified. Assuming that the noise is Gaussian, additive and white, remove the noise and high-boost the 'signal' in the block!
- `Method 3`: Now it's your turn :-) How would you further highligh the block with respect to the rest of the image? Remember to point out not only the strength, but also the weakness of your method!!

(b) [4p] You have a binary image such that 90% of the pixels have value 1. Compute the single-pixel entropy H_1, and explain what this quantity mean. Compute the theoretical maximum compression without loss, if each pixel is coded separately. Look again at the resulting H_1, but this time 'in the eyes'! Anything strange to point out? Or maybe Shannon was a visionary scientist able to predict the future??

(c) [2p] You have an image that has been processed using the fast wavelet transform (FWT). The set of diagonal detail coefficients at level 3 is of size 128×128. What are the sizes of the original and of the transformed images? The set of approximation coefficients is of size 16×16. At which level has the FWT been computed?

3 Cooling down: MISCELLANEA [3 points]

(a) [3p] In your opinion, what is the most interesting topic of the course? Explain how important this topic is in the context of image processing, and how important it is for your studies/job.