

IMAGE PROCESSING (RRY025)

One of the Exams in 2011/2012

1 IMAGE ENHANCEMENT/RESTORATION [15 points]

- (a) [2p] Describe histogram equalization as a tool for image enhancement.
- (b) [2p] Same question as in (a), but for histogram specification (matching).
- (c) [2p] Describe the ideal low-pass filter as a tool for noise reduction, discuss its advantages and disadvantages, and explain for which type of noise it can be used.
- (d) [2p] Same questions as in (c), but for the Gaussian low-pass filter.
- (e) [7p] You have a digital photo of 1024×1024 pixels. The quality of the photo is high only within the central 896×896 pixels. The surrounding 'frame', which has a thickness of 64 pixels [$64 = (1024 - 896)/2$], is polluted by additive Gaussian white noise of unknown standard deviation. This is unfortunate because such a 'frame' encloses important information, which you absolutely want to restore. Indeed, you took this photo on a very special occasion, using a camera that was just about to break :(So explain in detail, and with illustrations, how you would de-noise the photo!

2 MISCELLANEA [15 points]

- (a) [3p] Suppose that you have an image of 1010×1020 pixels, and that you want to transform it using Fourier or wavelet methods. What should you do first? And why? And if your image is of size 1020×1030 or 1030×1040 ? Are you sure? Think again! For example, if the image is of size 1025×1025 ? Explain why!!
- (b) [4p] Suppose that you have a low-contrast image, and that you enhance it by equalizing its histogram. Suppose also that you want to compress both images (the original one, and the enhanced one) without loss, coding each pixel separately. Which one of these two images can be compressed more? And why?
- (c) [5p] Consider a signal $S(X)$ that is almost perfectly regular: it is continuous, together with its 1st and 2nd derivatives. But its 3rd derivative has a discontinuity at a certain point X_0 . The signal is also very simple: it is a polynomial of degree 3 both for $X < X_0$ and for $X > X_0$. How would you detect the 'breakdown' point X_0 ? What would be the uncertainty ΔX of your detection? Explain in detail!
- (d) [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.