

IMAGE PROCESSING (RRY025)

One of the Exams in 2014/2015

1 IMAGE RESTORATION/ENHANCEMENT [15 points]

- (a) [2p] You have a signal that is noisy but WITHOUT distortions, and want to use the Wiener filter for reducing its noise. What are the two most important assumptions that must be satisfied for Wiener filtering the noisy signal?
- **Assumption 1:** the noise is additive
 - **Assumption 2:** the noise is Gaussian
 - **Assumption 3:** the noise is uncorrelated with the signal
 - **Assumption 4:** the noise is white
- (b) [3p] Show then how to Wiener filter the noisy signal (remember to specify what the point spread function is in this case).
- (c) [2p] Where do the two assumptions above (a) enter the filtering?
- (d) [3p] Suppose that the noise is of speckle type. Which of the two assumptions above (a) does it violate? Can you still de-noise the signal using the Wiener filter? How? Are you sure that you have not forgotten something?
- (e) [3p] Suppose that the noise is of Poisson type. Which of the two assumptions above (a) does it violate? Can you still de-noise the signal using the Wiener filter? How? Are you sure that you have not forgotten something?
- (f) [2p] For which common type(s) of noise is the Wiener filter useless? Why?

2 MISCELLANEA [15 points]

- (a) [2p] You have two versions of the same image: I1, sampled with 16×16 pixels; and I2, sampled with 1024×1024 pixels. Which one can you pre-compress more using wavelets? Why?
- (b) [4p] If you use bior4.4 (the FBI wavelet), which has a support size of 12 pixels and is significantly different from zero in a range of 3 pixels, then what is the theoretical maximum pre-compression that you can achieve in the two cases above without having significant wrap-around effects?
- (c) [2p] Consider an 8-bit image of size 128×128 , and suppose that its histogram is a Gaussian of mean $\mu = 64$ and standard deviation $\sigma = 16$. What does this tell you about the image? What is the flux (total intensity) of this image?
- (d) [4p] Consider now an image similar to the previous one (8 bits, 128×128 pixels, same content), but its histogram is Poissonian with standard deviation $\sigma = 8$. What does this tell you about the image? What is the flux (total intensity) of this image?
- (e) [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.