



The
University
Of
Sheffield.

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Autumn Semester 2012-2013 (1.5 hours)

EEE6086 Video Processing and Analysis 6

Answer **THREE** questions. **No marks will be awarded for solutions to a fourth question.** Solutions will be considered in the order that they are presented in the answer book. Trial answers will be ignored if they are clearly crossed out. **The numbers given after each section of a question indicate the relative weighting of that section.**

1. a. Calculate the impulse response of the cascade of a horizontal $[1, 0, 1]$ filter and a horizontal $[1, 3, 1]$ filter. What kind of filter is the cascade and what effect can be realised by applying this filter on an image? (5)
- b. Calculate the impulse response of the cascade of a horizontal $[1, 0, -1]$ filter and a vertical $[1, 2, 1]$ filter. What kind of filter is the cascade and what effect can be realised by applying this filter on an image? (5)
- c. Show an example of a 3×3 low-pass filter. Show how an edge enhancement filter can be obtained by using this 3×3 low-pass filter. Make sure the filter coefficients are normalised. (4)
- d. Show the outputs of a 3×3 box filter, a 3×3 median filter and a 3×3 α -trimmed-mean filter ($\alpha=5$) for the bold pixel on the following 5×5 image window. (6)

90	60	30	30	90
30	150	60	90	30
30	30	60	210	30
30	90	30	90	60
90	30	30	60	90

2. a. Name two enhancement techniques that usually do not need motion estimation and two enhancement techniques for which motion estimation is often critical? (4)
- b. Draw the diagrams of both the training and filtering processes of the “Trained Filter” in the application of integrated sharpening/deblurring and denoising. Make sure the “Trained Filter” is designed specific for this application. (6)
- c. Classification is critical for the “Trained Filter”. Adaptive Dynamic Range Coding (ADRC) is usually used to classify local structures. Explain how ADRC works. Write down the ADRC code of the following 3x3 image window. (4)
- | | | |
|----|----|----|
| 60 | 55 | 55 |
| 60 | 30 | 25 |
| 55 | 25 | 20 |
- d. Name two other examples of classification besides ADRC. What are the advantages and disadvantages of the trained filter compared with the New Edge Directed Interpolation (NEDI)? (6)

3. **a.** Motion estimation is required in both video compression/coding and picture rate conversion. What's the difference between the motion estimation methods in these two applications? (4)
- b.** What is the major drawback of a full search motion estimator? Name two classical methods to tackle this drawback. (3)
- c.** The 3-Dimensional Recursive Search (3DRS) block matcher is a very efficient true motion estimator. What are the two assumptions this algorithm based on? What constitutes the candidate set of the 3DRS blocking matching algorithm? (5)
- d.** Describe a method to evaluate the performance of a true motion estimator. (4)
- e.** Describe how a simple motion adaptive de-interlacing method works. (4)

- 4.** **a.** Describe how the bilateral filter works. Which two terms are the weighting coefficients dependent on? What are the three difficulties of the bilateral filter? **(6)**
- b.** Describe how the non-local means algorithm works. On what kind of images would the non-local means algorithm work the best? **(5)**
- c.** Between Gaussian noise and compression artifacts, which is the bilateral filter more effective for? Why? **(4)**
- d.** Pixel-based texture synthesis is time-consuming. The coherency search can be used to speed up the process. Illustrate in a drawing how the coherency search works. **(5)**

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