Data Provided: None

The University Of Sheffield.

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Autumn Semester 2013-2014 (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. Image enhancement techniques are usually applied to make legacy video look more pleasant in modern displays. Name three enhancement techniques that are often used. What techniques would need motion estimation? **(5)**

b. Show the outputs of a 3x3 box filter and a 3x3 median filter on the following 5x5 image window. Output pixels on the border can be ignored.

100	30	30	30	90
30	100	0	90	30
30	30	100	250	30
30	90	30	100	30
90	30	30	30	100

(6)

c. Show an example of the filter coefficients of a 2D high-pass filter and a 2D low-pass filter. Linear filters are usually not effective for shot (salt and pepper) noise. What kind of filters is more effective for shot noise? Name two filters belonging to that kind. **(6)**

d. Neighbourhood selection is another way of making filters adaptive. Name three neighbourhood selection methods. **(3)**

2. **a.** Briefly describe the "Trained Filter" algorithm and its advantages compared to classical adaptive filters. **(3)**

b. Draw the diagrams of both the training and filtering processes of the "Trained Filter" in the application of image up-scaling. **(5)**

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.

50	52	85
51	53	87
85	88	92

(4)

d. What is the drawback of ADRC in terms of its code length? List three methods to shorten the ADRC code. How are horizontal and vertical object edges distinguished from the blocking artefact? **(5)**

e. What are the similarities and differences between the trained filter and the New Edge Directed Interpolation (NEDI)? **(3)**

3. **a.** Frame rate up-conversion is used to convert video sequences from low frame rate to high frame rate. The simplest method is called frame repetition. What will cause frame repetition to be problematic? What technique is usually applied to solve this problem? **(4)**

b. Draw a diagram of the blocking matching motion estimation algorithms, showing the current block, search area and candidate vector. **(5)**

c. A full search is time-consuming. Name two methods to make the search more efficient. **(2)**

d. The 3-Dimentional Recursive Search (3DRS) block matcher is a very efficient true motion estimator. What are the two assumptions that this algorithm is based on? **(4)**

e. What constitutes the candidate set of the 3DRS blocking matching algorithm? **(3)**

f. What would be a major problem for motion estimation in a video sequence where the foreground object moves fast in front of the background? **(2)**

4. **a.** Describe how the bilateral filter works. Which two terms are the weighting coefficients dependent on? **(4)**

b. Illustrate what the filter kernel of a bilateral filter looks like for a point to the right of the edge in the 1D signal shown below, if Gaussian is used for smoothing. Draw the output of this signal after bilateral filtering. **(4)**

c. What are the three difficulties of the bilateral filter? Name two variants of the bilateral filter that improve its performance. **(5)**

d. Describe how the non-local means algorithm works. On what kind of images would the non-local means algorithm work the best? **(3)**

e. What is the major drawback of non-local means? How to tackle this problem in practice? **(4)**

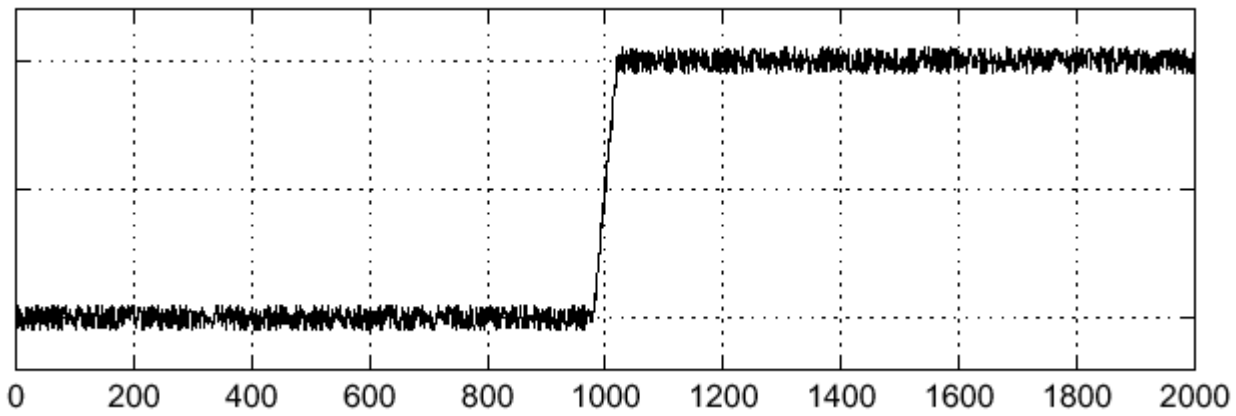

FIGURE 1. A 1D SIGNAL CONTAINING NOISE.

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