

Video Processing and Analysis (EEE6086) – Model Answers 2011/12

1.

a.

(5)

$$\begin{array}{cccccc}
 1 & 3 & 1 & & & \\
 & 2 & 6 & 2 & & \\
 & & 1 & 3 & 1 & \\
 \hline
 1 & 5 & 8 & 5 & 1 &
 \end{array}$$

The cascade is a 5-tap horizontal low-pass filter: [1, 5, 8, 5, 1]. The effect is smoothing/blurring.

b.

(5)

$$\begin{array}{ccc}
 1 & 2 & 1 \\
 0 & 0 & 0 \\
 -1 & -2 & -1
 \end{array}$$

The cascade is a 2D high-pass filter. The effect is enhancement of horizontal edges.

c.

(4)

$$\begin{array}{|c|c|c|} \hline 0 & 0 & 0 \\ \hline 0 & 1 & 0 \\ \hline 0 & 0 & 0 \\ \hline \end{array} + \left(\begin{array}{|c|c|c|} \hline 0 & 0 & 0 \\ \hline 0 & 1 & 0 \\ \hline 0 & 0 & 0 \\ \hline \end{array} - \frac{1}{15} \begin{array}{|c|c|c|} \hline 1 & 2 & 1 \\ \hline 2 & 3 & 2 \\ \hline 1 & 2 & 1 \\ \hline \end{array} \right) = \frac{1}{15} \begin{array}{|c|c|c|} \hline -1 & -2 & -1 \\ \hline -2 & 27 & -2 \\ \hline -1 & -2 & -1 \\ \hline \end{array}$$

d.

(6)

Median filter output:

30	60	60
30	90	60
30	30	60

α -trimmed-mean filter ($\alpha=3$) output:

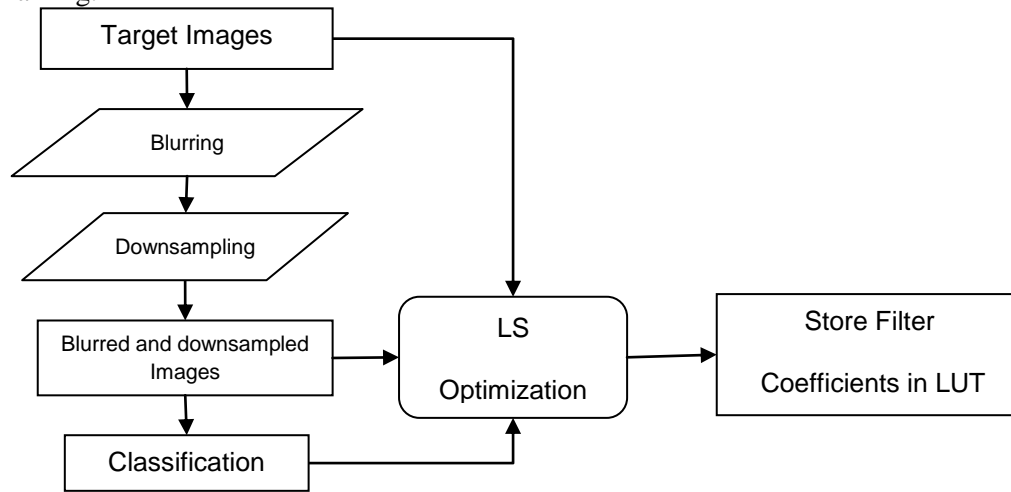
40	60	60
40	90	70
30	50	60

2.

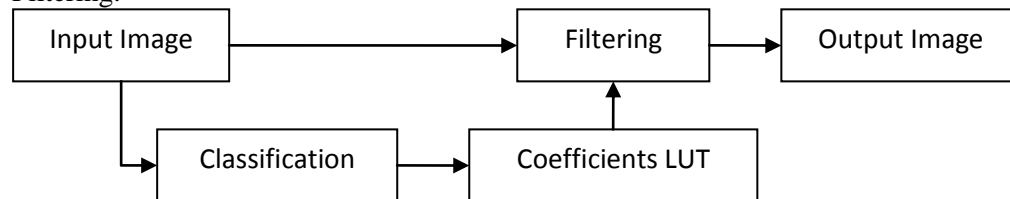
a.

(6)

Training:



Filtering:



b.

(4)

In ADRC, each pixel value is compared to the average. For a pixel value higher than the average, 1 is assigned as the class code for that pixel; otherwise, 0. The final code is the concatenation of the class codes in all the pixels in the neighbourhood.



c.

(5)

In the application of deblocking, ADRC is not enough for classification, because just ADRC is not able to distinguish horizontal and vertical edges from the blocking artefact.

To distinguish horizontal and vertical object edges from the blocking artefact, the structure (ADRC) should be combined with the complexity (activity) measure for classification.

d.

(5)

Filter coefficient optimisation in both the trained filter and NEDI is based on least squares optimisation.

The coefficient optimisation in the trained filter is based on an offline training process and classification. So the online processing of the trained filter is more efficient but requires extra memory to store the LUT. The coefficient optimisation in NEDI is done during filtering and based on the assumption that interpolation is scale invariant. So NEDI is less efficient but requires no memory for storing filter coefficients.

3. (4)
- a. Enhancement techniques that require no motion estimation (any two of the following):
Sharpness enhancement
Contrast enhancement
Resolution up-conversion
Colour enhancement
Denoising
Coding artefacts reduction
- Enhancement techniques that usually require motion estimation:
Picture rate conversion
De-interlacing
- b. (3)
The major drawback of a full search motion estimator is it is very slow. Methods to tackle this problem:
Sub-sampled search
One-at-a-time search
- c. (5)
The two assumption that 3DRS is based on:
Objects are larger than blocks
Objects have inertia
- The candidate set of the 3DRS blocking matching algorithm:
Spatial candidates
Temporal candidates
Update candidates
- d. (4)
Single-sided prediction combined with median filtering in occlusion areas
Double-sided prediction
- e. (4)
A simple motion adaptive de-interlacing method works as follows:
If motion is detected, intra-field edge dependent interpolation is used; otherwise, use field insertion (copy pixels from the previous field).

4.

a. (5)

Compared with the Gaussian filter, the advantage of the bilateral filter is it preserves edges better. The three difficulties of the bilateral filter are:

Poor smoothing in high gradient regions

Smoothes and blunts cliffs, valleys and ridges

Can combine disjoint regions

b. (6)

Both the bilateral filter and non-local means try to explore the similarity/correlation in an image. The bilateral filter averages local neighbouring pixels that have similar intensities. Non-local means averages non-local neighbours with similar neighbourhoods.

Non-local means tends to be computationally more expensive, because it has to search similar patches in a larger area and the calculation of the similarity between two patches is also costly.

c. (4)

The bilateral filter can be used on (a), because there are many strong edges in the image. The non-local means algorithm can be used on (b), because there are many repetitive patterns in the image.

d. (5)

The two groups of methods for texture synthesis are:

Parametric methods

Non-parametric/example-based methods

The applications of texture synthesis include:

Inpainting

Texture transfer

Image analogies

Super-resolution