

B31XM – Advanced Image Analysis
Programming Assignment 1: Non-linear averaging for image processing
(5% of the final mark, submit your report via Vision by Friday 25 September 2013)

Given an grey-scale image $I(x,y)$, consider the following non-linear iterative process:

$$I_0(x,y) = I(x,y), \quad I_{n+1}(x,y) = \frac{\sum_{i,j=-1}^1 w_{ij} I_n(x+i, y+j)}{\sum_{i,j=-1}^1 w_{ij}}$$

$$w_{ij} = \exp\{-k|I_n(x,y) - I_n(x+i, y+j)|\}$$

where k is a positive constant. Note that the weights $\{w_{ij}\}$ depend on the pixel positions (x,y) and the iteration number n . After a certain number of iterations you should get results similar to those shown in the picture below: small-scale image details are removed while salient image edges are sharpened. So it leads to an edge-aware base-detail decomposition of a given image. Here k and the total number of iterations are user-specified parameters.



The above non-linear image filtering scheme can be considered as a simplified version of the nonlinear diffusion approach proposed by Pietro Perona and Jitendra Malik [1].

[1] P. Perona and J. Malik, "Scale-space and edge detection using anisotropic diffusion", *IEEE Transactions of Pattern Analysis and Machine Intelligence*, Vol. 12, No. 7, July 1990.

Implement the above non-linear iterative image filtering procedure and investigate how it can be used for a better edge detection and image segmentation.