EE3206/EE3206E INTRODUCTION TO COMPUTER VISION AND IMAGE PROCESSING

Semester 1, 2013/2014

Tutorial Set C

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1. (a) Describe a simple procedure, based on the bubble sort algorithm, for computing the median of an $k \times k$ neighbourhood. Obtain an expression for C_1, the number of comparison operations that are needed.

   (b) Instead of sorting k^2 values each time the window is moved to the next pixel, we can remove k values corresponding to the discarded pixels from the sorted list, and insert the new k values in the appropriate positions in the list. Determine the number of comparison operations, C_2 that are needed with this procedure.

   (c) Calculate the ratio C_1/C_2 for $k = 3, 5, 7$.

2. A noisy 8×8 image consists of a bright object on a dark background. The nominal gray values of the background and object are, respectively, 60 and 160. Show the result of applying the noise reduction techniques below to the image. (Use 3×3 windows; hence, the resulting images are of size 6×6.)

   (a) neighbourhood averaging

   (b) median filter

   (c) mid-point filter

   (d) alpha-trimmed mean filter ($p = 2$)

60	72	66	63	70	46	46	80
64	72	60	44	76	40	76	50
70	58	48	64	76	78	50	76
64	0	50	68	56	40	74	64
60	54	74	52	158	146	162	152
42	54	60	68	164	140	142	148
66	52	78	54	160	172	174	166
58	40	50	66	156	146	180	142

3. An image is contaminated by salt noise of probability 0.01. The image and its histogram are shown below.

   (a) Is the MMSE filter effective in removing noise in this case? Discuss this by considering a neighbourhood centred at a noise point (gray level = 255).

   (b) Discuss the suitability of applying image averaging to reduce noise in this image.