

Exercises for Multimedia Databases

Sheet 2 (until 12.11.2009)

Please note that you need **50%** of all exercise points to be admitted for the final exams. Exercises have to be turned in until **Thursday** before the next lecture and should be completed in teams of two students each. Write both names and “Matrikelnummer” on each page. If you have multiple pages, staple them together! Please hand in your solutions on **paper** into the mailbox at the IFIS floor or to our secretary (Mühlenpfordtstraße 23, 2nd floor). You may answer in either German or English.

Exercise 1: (P)

Calculate the granularity (F_{crs} in the following algorithm description) and provide it together with the histogram of the best sizes (Sbest) for each of the following images, according to the Tamura texture measure:

1. http://www.gtccolcomp.com/erc/interwritebackgrounds/checkers_board.gif
2. <http://www.lsv.ens-cachan.fr/~zhang/workshop/image/nanjing/satellite.jpg>
3. <http://earthobservatory.nasa.gov/IOTD/view.php?id=40997>

Necessary steps for calculating the granularity (“IEEE Transaction on Systems, Man, and Cybernetics” Volume 8, Edition 6, article “Texture Features Corresponding to Visual Perception”, Tamura, Mori and Yamawaki):

Step 1: Take averages at every point over neighborhoods whose sizes are powers of two, e.g., 1×1 , 2×2 , ..., 32×32 . The average over the neighborhood of size $2^k \times 2^k$ at the point (x, y) is

$$A_k(x, y) = \frac{1}{2^{2k}} \sum_{i=x-2^{k-1}}^{x+2^{k-1}-1} \sum_{j=y-2^{k-1}}^{y+2^{k-1}-1} f(i, j)$$

where $f(i, j)$ is the gray-level at (i, j) .

Step 2: For each point, at each point, take differences between pairs of averages corresponding to pairs of non-overlapping neighborhoods just on opposite sides of the point in both horizontal and vertical orientations. For example, the difference in the horizontal case is

$$E_{k,h}(x, y) = \left| A_k(x + 2^{k-1}, y) - A_k(x - 2^{k-1}, y) \right|$$

Step 3: At each point, pick the best size which gives the highest output value:

$$S_{\text{best}}(x, y) = 2^k$$

where k maximizes E in either direction, i.e.,

$$E_k = E_{\text{max}} = \max\{E_1, E_2, \dots, E_L\}.$$

Step 4: Finally, take the average of S_{best} over the picture to be a coarseness measure F_{crs} :

$$F_{\text{crs}} = \frac{1}{w \times h} \sum_{i=0}^{w-1} \sum_{j=0}^{h-1} S_{\text{best}}(i, j)$$

where w and h are the effective width and height of the picture, respectively.

Note: Start by transforming the images to gray. Also consider the fact that the provided algorithm, is not specific in the case of $k=0$, on how to lay the window. There is also an ambiguity case if there are more k values which build the maximum difference for one pixel. Make you decisions in this cases, and argument them. Also worth noticing, is the fact that there are pixels, at the boundaries of the images, which cannot be integrated in any window of some k values due to the non-overlapping condition.