Cryptographic passports & biometrics, summer 2009 MICHAEL NÜSKEN, KONSTANTIN ZIEGLER

12. Exercise sheet Hand in solutions until Monday, 20 July 2009.

Any claim needs a proof or argument. Answer in complete sentences and your own words. A verbatim quote is never a complete answer.

Exercise 12.1 (More about large scale automation). (3+2 points)	
Read the FBI pages about IAFIS.	
(i) How large is the archive now?	1
(ii) How many requests per day are made? Or:	+1
(iii) How is the archive accessed?	1
(iv) How reliable is the system? What are the false accept and reject rates? (Name a source for these rates, please, if you find that.)	+1
(v) How long does a single search take? (CPU? turn around time?)	1

Exercise 12.2 (FVC).

(7 points)

The first Fingerprint Verification Competition was held in 2000, see their webpage under http://bias.csr.unibo.it/fvc2000/.

(i)	What do you have to provide in order to compete?	2
(ii)	Pick three algorithms and describe why and in which situation you would	3
	choose one over the others based on the results, see http://bias.	
	csr.unibo.it/fvc2000/results.asp.	

(iii) What is the reason that "For a correct interpretation of the results, Avg EER alone is not an exhaustive metric, but Avg REJ ENROLL should be also taken into account"?

Exercise 12.3 (Gabor-Filtering).

(14+4 points)

We want to observe some effects of Gabor-Filtering on the fingerprint given on http://en.wikipedia.org/wiki/File:Fingerprintonpaper.jpg.

You will find a image manipulation program helpful, that is able to zoom in on specific pixels and output their respective greyscale value. To measure the intensity in *x*-direction of a specific pixel A, consider the 8 neighbouring pixels and weigh their greyscale according to the following scheme:

-1	0	1	
-2	A	2	
-1	0	1	

The sum of these values gives I_x which is a suitable approximation to the derivative $\partial I/\partial x$. Turning the scheme by 90 degrees gives the weights for I_y .

(i) Choose 4 pixels in the picture at random and compute the parameter θ for the Gabor-Filter by

(12.4)

$$heta = \arctan\left(rac{I_y}{I_x}
ight)$$

Draw a corresponding arrow into the image.

We also want to consider a more refined choice of θ according to

(12.5)
$$\theta = 90^{\circ} + \frac{1}{2}\arctan\left(\frac{2G_{xy}}{G_{xx} - G_{xy}}\right)$$

where

$$G_{xy} = \sum_{-w/2 \le h, k \le w/2} I_x(x_A + h, y_A + k) \cdot I_y(x_A + h, y_A + k)$$

at the point A with coordinates (x_A, y_A) .

- (ii) Examine the relation between (12.4) and (12.5) for the simple case w = 0.
- (iii) Write a programm in a language of your choice which computes θ according to (12.5) for a reasonably large frame size w, e.g. w = 15. Use it to add "more precise" arrows at the points established in Exercise 12.3(i). Compare the quality of the two results.

+4

6

Exercise 12.6.

(0+8 points)

An online Gabor filter simulation is available on http://matlabserver. cs.rug.nl/cgi-bin/matweb.exe.

- (i) Use as input image the fingerprint s.png and fiddle with the parameters +4 to achieve an output that qualifies as fingerprint.
- (ii) Use as input synthetic1.png and play with the parameters to make +4 the vertical lines disappear without "ruining" the skew lines.