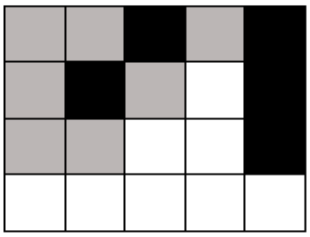
Exercise Multimedia Technology
WS 2003/2004

Sheet 11 (January 23th, 2004)

Exercise 11.1 Color analysis

The image below shows a magnified image clipping.



- Invent an algorithm for calculating an image's histogram. You can expect the image to be of size N x M using 256 different gray values per pixel.
- Calculate the histogram of the image above.
- Calculate the CCV based on the image above. The neighborhood shall be defined as a 4-pixel neighborhood which means that vertical and horizontal pixels are considered (no diagonal ones). How many regions are contained? What is the average size of a region in pixels?

Note: In case you might want to have further information on color coherence vectors read section 3 of the following paper. It contains a very compact description of CCV. The mentioned threshold *tau* in the paper corresponds to the average size of the regions calculated above.

http://www.informatik.uni-mannheim.de/informatik/pi4/data/pass96comparing.pdf

Exercise 11.2 Cut detection

(1) How would you compare two histograms H_1 and H_2 ?

(2) Develop an algorithm which detects cuts based on color histograms. The image should be given as char image[height][width][frame].

(3) Comment on the reliability of histograms in the context of cut detection and provide solutions

for possible problems.

Exercise 11.3 Gradients

The magnitude of the gradient of an image I (x,y) is derived as follows:

- $$|\nabla I(x,y)| = \sqrt{\left(\frac{\partial I(x,y)}{\partial x}\right)^2 + \left(\frac{\partial I(x,y)}{\partial y}\right)^2}$$

The partial derivations can e. g., be approximated as follows:

- $$\frac{\partial I(x,y)}{\partial x} \approx \frac{I(x+1,y) - I(x-1,y)}{2}$$
- $$\frac{\partial I(x,y)}{\partial y} \approx \frac{I(x,y+1) - I(x,y-1)}{2}$$

In the following table you get the gray values of an image.

100	100	200	100	200	100
100	100	200	100	200	100
100	100	200	200	200	100
100	100	200	200	200	100
100	100	200	100	200	100
100	100	200	100	200	100

Calculate the gradients of the second row and the gradient magnitudes of the third column. If you need additional values at the borders set them to zero.

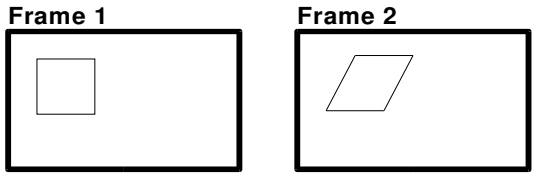
To what kind of visual effect does the gradient yield? Explain why.

Exercise 11.4 Panoramic images

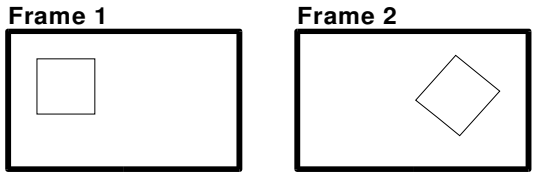
(1) In the lecture you have learned how to obtain a tube-like reconstruction of several images into a panoramic one. Extend the approach to a spherical projection. What additional degrees of freedom does the spherical approach cause for the photographer?

(2) What kinds of transforms have been applied between frame 1 and frame 2 (see next figure). Find a parametric description for each transform.

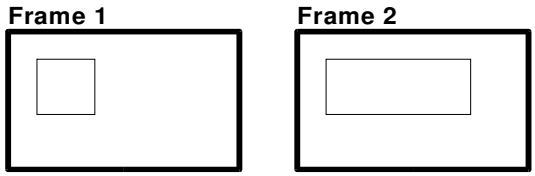
(1)



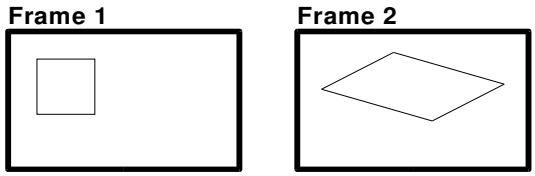
(2)



(3)



(4)



(3) Prove that a rotation can be expressed by means of two shears.