Chapter 6:Region segmentation and texture analysis.

Exercise 6.1:Counting items.

EIKONA provides a tool for counting the objects (white connected regions) in a binary image.As an example,suppose that we have a thresholded image of BABOON (threshold=150) in a BW buffer.We access the object counting tool by selecting the menu option "***Black and white*⇨*Analysis*⇨*Region Segmentation*⇨*Count items***".After selecting the thresholded image as the source buffer an information window appears,informing us that this binary image of BABOON consists of 331 sets objects (this number depends on the threshold that was used during thresholding of the original image).

Exercise 6.2:Segmenting an image.

EIKONA can also be used to segment a grayscale image to a number of uniform regions.For example,we can segment the image of BABOON to 4 regions by selecting the menu option "***Black and White*⇨*Analysis*⇨*Region Segmentation*⇨*Segment***" and entering 4 for the *˝umber of regions* field of the dialog box that appears (source and destination bufers are specified as usual).Figure 1 depicts the segmented image of BABOON,where each gray scale represents a different region.

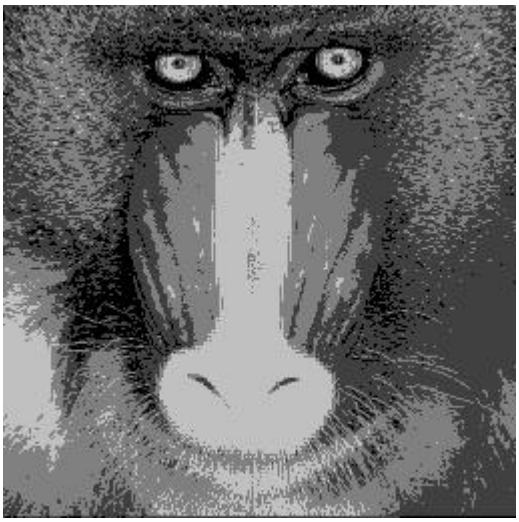

Figure 1:The image BABOON segmented in four regions.

Exercise 6.3:Region growing.

We can segment an image using the region growing technique,which can be initiated by selecting the menu option "***Black and White*⇨*Analysis*⇨*Region Segmentation*⇨*Region Grow***".We select the appropriate input and output image buffers and give the *Threshold* value which will distinguish one region from another.A non-modal window will appear letting us select the "seeds'' (up to 256) before clicking the " OK " button.Ideally,we should select one seed for each region to be created.This process can be automated by using the image histogram.We can select the "seeds" to be the pixels of the image whose brightness values correspond to the peak values of the histogram.

Figure 2 shows the result of applying region growing on CIRCUIT with a threshold of 20 and the seeds picked randomly all over the image.

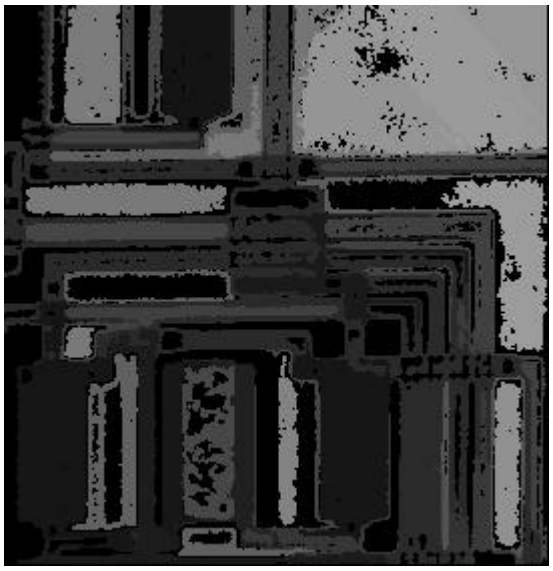

Figure 2:The result of region growing procedure on CIRCUIT using a threshold of 20 and randomly selected seeds.

Exercise 6.4:Region splitting.

In this exercise,we use the Region Split algorithm to perform segmentation on BABOON.The Region Split algorithm is a recursive top–down method.Initially,the algorithm assumes that the input image is homogeneous.If this is not true,then the algorithm splits the input image into four sub-images.This process continues recursively until all the regions in the image are homogeneous.The homogeneity is checked against a given threshold,expressing the maximum brightness value range of a homogeneous region.

To perform region splitting in EIKONA,we select the menu option "***Black and White*⇨*Analysis*⇨*Region Segmentation*⇨*Region Split***" .In the dialog box that appears,we specify the source and destination buffers and

enter a value for the *Threshold* field.The larger the threshold value,the less the regions in the output image.

In Figure 3,we present two examples of region splitting on BABOON:

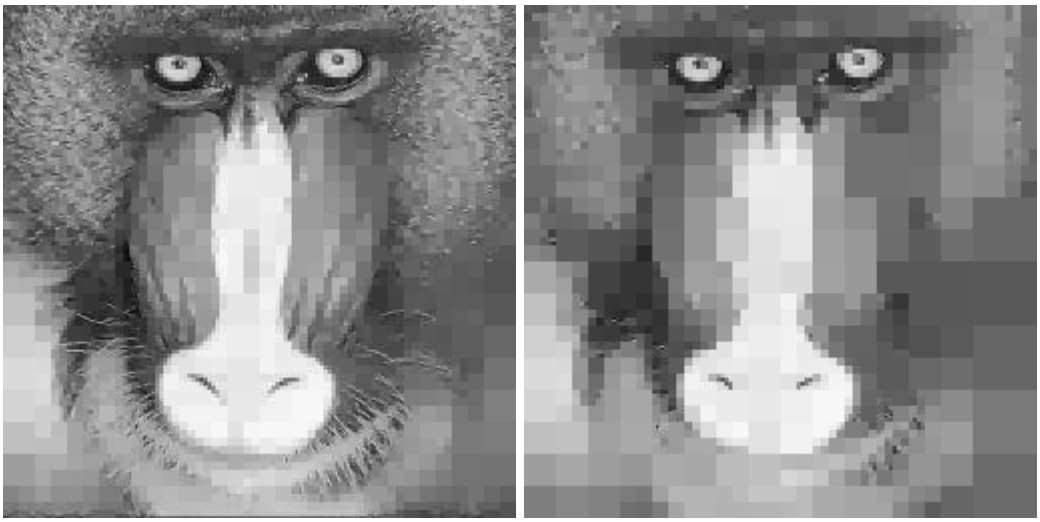

Figure 3:Examples of region splitting on BABOON:
a)Threshold used: 75,Number of regions: 9493
b)Threshold used:125,Number of regions: 1405

Exercise 6.5:Region splitting with merging.

The Region Splitting algorithm tends to produce rectangular regions in the output image.Moreover,it cannot efficiently preserve the region outlines.This can be seen in the images of Figure 3.A variation of the algorithm can be used in order to overcome those problems;when a homogeneous region is found,it is checked whether it can be merged with other homogeneous regions adjacent to it.This algorithm can be found in EIKONA under the menu option "***Black and White*⇨*Analysis*⇨*Region Segmentation*⇨*Region Split Merge***".In the dialog box that appears,after making the above selection,we enter the source and destination buffers,the *Threshold* value and a value for the *Maximum number of regions* in the output image.This number is used in the region merging process.

An example of region splitting with merging can be seen in Figure 4.

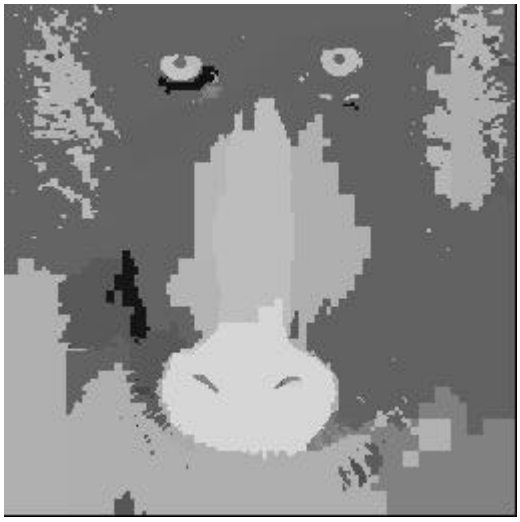

Figure 4: Result of region splitting with merging on BABOON
(Threshold: 75
Max.number of regions: 500
Number of output image regions: 194)

Exercise 6.6:Computing the Gray Level Differences Histogram of an image.

The Gray Level Differences Histogram of an image can be computed in the following way: we choose option "***Black and White*⇨*Analysis*⇨*Texture*⇨*Gray Level Dif.Histogram***".Assuming that the BW image buffer 0 contains the image BABOON,we specify BW Buffer 0 as the sourcebuffer,**<NewBuffer>** as the destination buffer and enter 1,1 as the displacement coordinates.The output is a window containing the visual information of the Gray Level Differences Histogram.It is given in Figure 5.

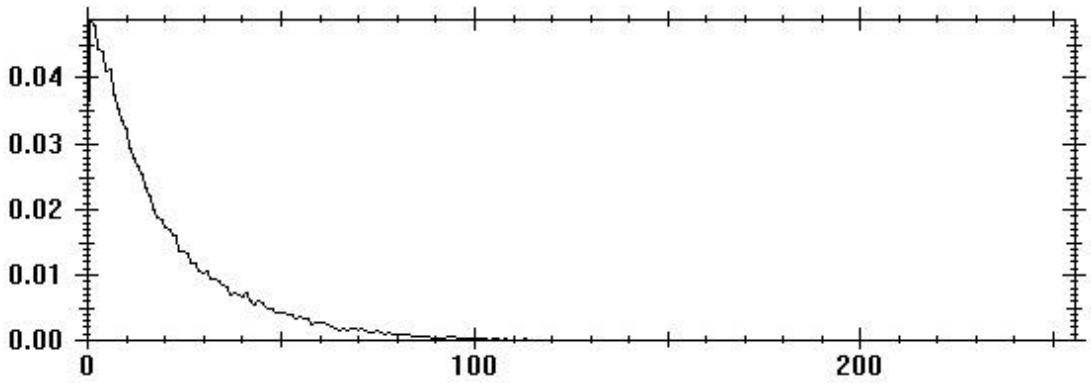

Figure 5:The Gray Level differences histogram of BABOON.

Some valuable information about this histogram can be calculated through the menu option "***Black and White*⇨*Analysis*⇨*Texture*⇨*Gray***

Lev.Dif.Hist.Parameters".By doing so for the above histogram,we get the following results:

Contrast: 736.796204
Ang.Sec.Moment: 0.200167
Entropy: 3.975667
Mean value: 19.338505

Exercise 6.7:Computing the Angular and Radial Power Spectrum Distribution.

One other interesting feature provided by EIKONA is calculation of the power spectrum distribution.By selecting the menu option "***Black and White⇨Analysis⇨Texture⇨Angular-Radial***" we can obtain visual information about the angular and radial distribution of the power spectrum of an image in a format similar to the one used to display histograms.For example,the radial and the angular distribution of the power spectrum of BABOON are shown in Figures 6 and 7.The peaks of the angular distribution of BABOON (Figure 7) reveal the existence of many vertical lines in it.Moreover,the form of the radial distribution (power concentration in the low frequencies) reveals the "soft" texture of BABOON.

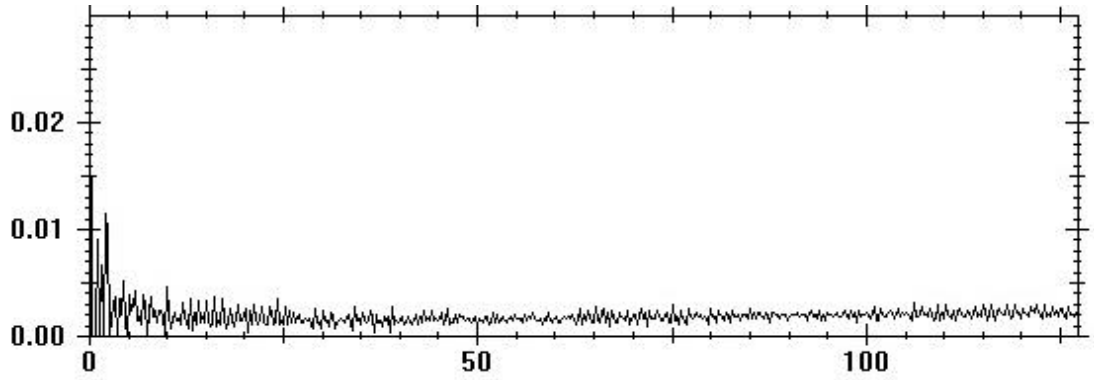

Figure 6:Radial power spectrum distribution of BABOON.

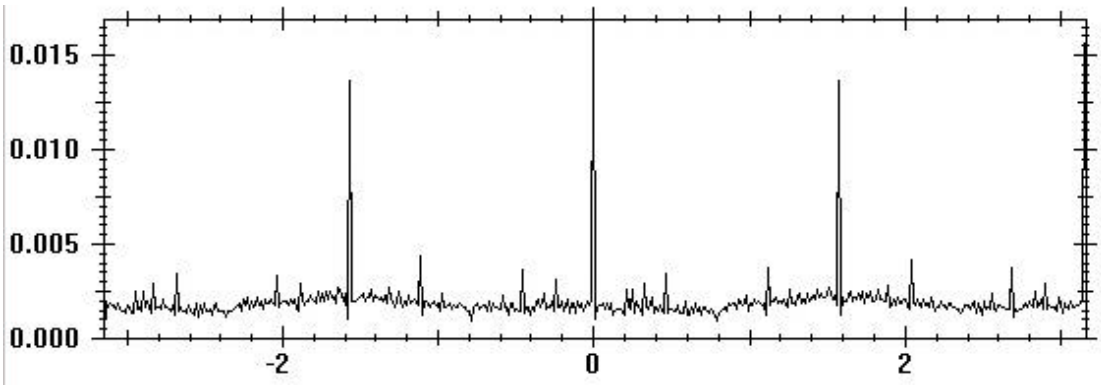

Figure 7:Angular power spectrum distribution of BABOON.