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Digital Image Processing Fundamentals

Chapter 6

Image Segmentation Algorithms

Answers to the Chapter Questions

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Chapter 6

Image segmentation algorithms

6.1 Introduction

Questions/Answers
1. What is the definition of the pixel neighborhood?
   In many applications, it is important to check the connectedness of a region, something that it is done using the neighborhood definition.

2. What is the definition of region connectedness?
   A region R is called ***connected*** if any two pixels (x_A, y_A), (x_B, y_B) belonging to R can be connected by a path (x_A, y_A), ..., (x_{i-1}, y_{i-1}), (x_i, y_i), (x_{i+1}, y_{i+1}), ..., (x_B, y_B), whose pixels (x_i, y_i) belong to R and any pixel (x_i, y_i) is adjacent to the previous pixel (x_{i-1}, y_{i-1}) and the next pixel (x_{i+1}, y_{i+1}) in the path.

6.2 Image segmentation by thresholding

Questions/Answers
1. What problem occurs when the histogram has only one lobe?
   When the image histogram has only one lobe then a threshold can not be found.

2. What problem occurs when the image has low luminance?
   Then the histogram of the image is restricted to a small region of luminance intensity and uniform thresholding does not give good results.

3. What are the advantages of the non-uniform thresholding?
   Non-uniform thresholding solves the above mentioned problem, since it first modifies the histogram in order to be better distributed in all luminance values.

6.3 Split/merge and region growing algorithms

Questions/Answers
1. What are the advantages/disadvantages if we use more than one seed in a growing technique?
   By using more than one seed, we expect a better segmentation of an image, since more seeds lead to more homogeneous regions. On the other hand, the probability of splitting a homogeneous region in two or more segments increases.

2. What are the characteristics of a non-homogeneous region?
   The luminance values have great standard deviation value.

3. What are the disadvantages of a split method?
    The possible creation of neighboring and homogeneous regions that are not connected. Besides, this method does not preserve small regions and contours. The regions that are created have visible square shape. A large number of regions are created since connections are not allowed.

4. What are the disadvantages of a split/merge approach?
    The main disadvantage is that it does not preserve the *quadtree* structure. Besides, this method does not preserve small regions and contours. The regions that are created have visible square shape (less visible than in previous case).

6.4 Relaxation Algorithms in Region Analysis

Questions/Answers
1. How can we define the initial probabilities of the confidence weight for each pixel in an area?
    The initial probability of a pixel to belong in a region is usually defined as the inverse of the difference between its luminance value and the regions arithmetic mean of the luminance values.

2. What are the disadvantages of the relaxation algorithms?
    The efficiency of the method is strongly dependent to the selection of the compatibility functions. If they are wrongly selected it is possible to lead to algorithm instability.

6.5 Connected component labeling

Questions/Answers
1. How can we find the number of objects in a binary image?
    First a connected component (object) is detected in an image and then it is subtracted from the image. Then, the algorithm is reapplied until no object can be found.

2. What are the disadvantages of a recursive algorithm as "fire" algorithm?
    The need of iterative local operations increases the computational time of the algorithm.

3. How can we find the number of objects in a graylevel image?
    First, the image should be converted to a binary image using a threshold or another segmentation method. Then, a connected component algorithm is applied.

6.6 Texture description

Questions/Answers

1. What are the advantages and disadvantages of the use of histogram for the texture description?
   The main advantage is the computational simplicity of the algorithm. The main disadvantage is that it cannot desribe local texture characteristics.

2. Do we expect small or long run-lengths, in natural images of objects?
   Assuming that natural images have great luminance changes, we expect more small run-lengths.

3. What is the information provided by the black horizontal run-lengths in a binary text image?
   From the black horizontal run-lengths distribution we can extract information regarding the size of the text characters.

4. What is the information provided by the white horizontal run-lengths in a binary text image?
   From the white horizontal run-lengths distribution we can extract information regarding the distance between text characters.

5. What is the type of autocorrelation function of an image with fine texture?
   If the texture is fine the drop-off rate is large.

6. What is the type of autocorrelation function of an image with coarse texture?
   If the texture is coarse the drop-off rate is small.

7. What is the type of power spectrum of an image with coarse texture?
   A coarse textured image has more power in low frequencies.