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Digital Image Processing Fundamentals

Chapter 5

Edge Detection Algorithms

Answers to the Chapter Questions

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5.2 Edge detection

Questions/Answers

1. Are the edge detectors high pass or low pass operators?
   They are high pass operators. The edges (changes) correspond to high frequencies.

2. Do the edge detectors increase or not the noise in the image ?
   They increase the noise. For example, the Laplace operator that performs a second order differentiation.

3. Where is edge direction necessary?
   In order to detect lines having various directions.

4. What are the disadvantages of the Laplace operator?
   The Laplace operator increases the noise in an image. It detects also erroneous edges especially in areas with low variance.

5.3 Edge thresholding

Questions/Answers

1. How can we choose the threshold T such that for example 5% of the pixels of the output of the detector lie above the threshold?
   First we calculate the histogram of the detectors output values. Then, we set the threshold at the point where only the 5% of the output pixels have values greater than the threshold.

5.4 Hough transform

Questions/Answers

1. Why model (5.4.2) is preferred than the model (5.4.1)?
   Because model (5.4.1) cannot detect vertical lines.

2. What problems do we have if the accumulator array *P(a,b)* has a big size ?
   The computational complexity and the necessary memory space are increased.

3. What problems do we have if *P(a,b)* has a small size ?
   The detection accuracy is reduced.

4. What problems we may have when using Hough Transform for finding the circle parameters ?
   A three dimensional parameter space is needed for a circle detection. So, the computational complexity and the necessary memory space are increased.

5.5 Edge-following algorithms

Questions/Answers

1. What is the meaning of the limitations in the equations (5.5.1)-(5.5.3)?
   Generally, the edges and the lines in an image tend to have low curvature. Edge-following algorithms take into account this property using the equations (5.5.1)-(5.5.3).

2. Why is dynamic programming used in edge following algorithms?
   The fundamental observation underlying dynamic programming is that any optimal path between two nodes of a graph has optimal subpaths for any node lying on it. Thus the optimal path between two nodes x_A, x_B can be split into two optimal subpaths x_A to x_i and x_i to x_B for any x_i lying on the optimal path x_A to x_B. Dynamic programming approach splits the optimization into *N* independent optimization steps.