



# Weak Coverage Area Detection Algorithms for Intelligent Networks Based on Large Data

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**Abstract.** Aiming at the problem of abnormal location often occurring in traditional weak coverage area detection algorithm of intelligent network, a detection algorithm of weak coverage area in intelligent network based on large data is proposed. Firstly, the detection data is collected by data acquisition method based on local characteristics, and then the gray level conversion of these detection data is used to realize the pre-processing of the detection data and the detection after pre-processing. The feature vectors are used to describe the feature points so as to realize the accelerated feature matching of the detected data. Then the region feature detection of the detected data is carried out, and finally the weak coverage area detection algorithm of the intelligent network based on large data is realized. Experiments verify the detection performance of the weak coverage area detection algorithm based on large data in intelligent networks, and draw a conclusion that the detection algorithm based on large data has a much smaller probability of abnormal location than the traditional weak coverage area detection algorithm in intelligent networks.

**Keywords:** Bigdata · Intelligent network · Weak coverage area · Detection algorithm

## 1 Introduction

Due to the huge information contained in image and video, it is impossible to accurately express the information of image and video with simple words. The weak coverage area detection of intelligent network under large data needs complex calculation to analyze the semantic information and then get the regional feature information and detect it correctly [1]. In the actual use of large data, it may face various transformations [2, 3]. Therefore, how to reduce the impact of noise, how to detect the weak coverage area of intelligent network based on large data and extract the feature information needs of the weak coverage area of intelligent network have become one of the hotspots in the current computer field [4, 5].

## 2 Weak Coverage Area Detection Algorithms for Intelligent Networks Based on Large Data

### 2.1 Data Acquisition

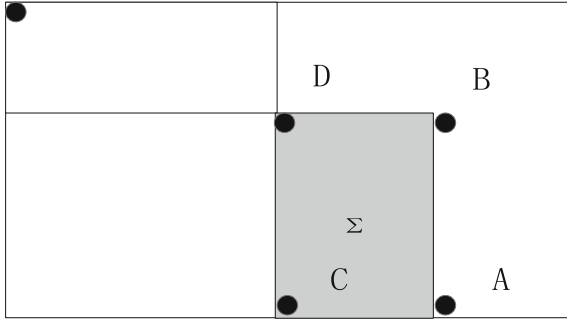
According to the type of feature information, the current data acquisition methods of weak coverage area detection algorithms in intelligent networks are mainly divided into data acquisition methods based on global features and data acquisition methods based on local features [6, 7]. Data acquisition based on global features is to describe the whole image with one feature through mathematical operations according to global features such as color and texture. Data acquisition based on local features is to find the more important region or location (called feature points) in the image by analyzing the image, and then describe each feature point with the image information around it, and get the feature value of the feature. With the application of large data more and more widely, data acquisition based on global characteristics has been unable to meet the data needs of large data detection. Therefore, as the basis of weak coverage area detection in intelligent networks, data acquisition method based on local features can effectively extract image feature information for image or video retrieval, which is widely used in image retrieval engine, network filtering and other systems.

### 2.2 Data Preprocessing

Intelligent network weak coverage area detection algorithm based on large data needs to convert the original image of image data into gray image after data acquisition [8]. Every point of gray image is represented by gray value. Then the integral image is calculated according to the gray image. The values of each point in the integral image are expressed by the gray sum of points in the rectangle formed by the coordinates of the origin and the current point in the gray image. For example, point D is expressed by its gray level in gray level image, while point D is expressed by the gray sum of all points in gray level area in integral image, it is shown as Fig. 1. In this way, the gray level and sigma of rectangular ABCD can be calculated conveniently by formula (1).

$$\Sigma = A - B - C + D \quad (1)$$

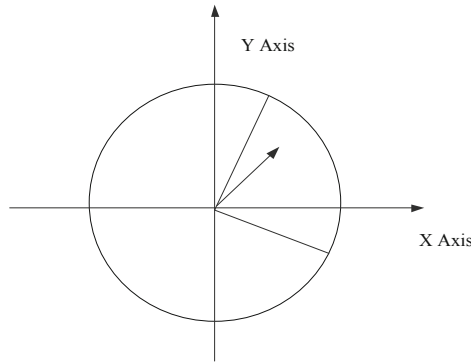
A, B, C and D are the values of points in the corresponding integral image. In the later feature detection and description, it is often necessary to calculate the gray sum of points in a rectangular region, so the integral image can reduce a lot of repeated memory access and computation. And no matter how large the area of rectangular ABCD is, after image abstraction, only four memory accesses and three addition and subtraction operations are needed to calculate the gray sum of interior points.



**Fig. 1.** Calculating the sum of the gray levels of a rectangle using an integral image

### 2.3 Feature Description

Characteristic vectors are used to describe feature points: centering on the feature points, sampling the area around the current feature points, and identifying some features in the area as the feature vectors of the feature points [9]. In order to ensure the stability of the feature vectors for rotation transformation, the algorithm needs to calculate the main direction of each feature point. When matching, the principal directions of the two feature points are aligned to ensure the stability of the feature for rotation transformation. The calculation method of characteristic direction is shown in Fig. 2.



**Fig. 2.** Characteristic direction calculating method

- (1) With the feature as the center and the radius of  $6S$  ( $s$  representing the scale of the feature point) as the circle, the Haar wavelet transform of the feature point is calculated and its gradient information  $(dx, dy)$  is obtained.
- (2) After obtaining the gradient information of the points around the feature points, the sum of the gradient values of all X-axis and Y-axis directions in the 60-degree sector area is calculated every 0.15 rad, and the  $\sum dx$ ,  $\sum dy$  and the weight  $(\sum dx)^2 + (\sum dy)^2$  are obtained at the end point.

- (3) The main direction of the feature points is expressed by the angle between the Y axis and the X axis.

After obtaining the main direction of feature points, the weak coverage area detection algorithm based on large data in intelligent networks needs to describe these feature points and generate a vector. The calculation feature window is used to show how to calculate the description of the feature points. The arrow represents the offset direction of the point relative to the direction of the feature points, the length of the arrow represents the gradient of the point, and the circular range represents the sampling range. Its radius is determined by the size of the S parameter of the image where the feature points are located in Gaussian filtering. It is 20s (s represents the scale of the feature points). The feature window is evenly divided into 16 sub-regions. In each sub-region, 25 points are sampled for Haar wavelet transform, and each sub-region is represented by vector  $(\sum dx, \sum dy, \sum |dx|, \sum |dy|)$ . In this way, the calculated feature window forms a 64-dimensional vector. Finally, the vector is standardized to get the description of the current feature points. In addition, the feature description can also be achieved through data image analysis [10]. Firstly, the characteristics of data image in weak coverage area of intelligent network are analyzed, and the characteristics of the number and distribution of feature points are analyzed. It is found that the number of image and the number of feature points are basically similar to the normal distribution. The ordinates in the coordinates are used to indicate the number of feature points in the image, and the abscissa is used to indicate the number of images with the current number of feature points. It can be seen that the number of feature points in most images is between 300 and 800; some images have no feature points; the largest number contains more than 2200 feature points; an average image contains 620 feature points; the largest number of images contains 500 feature points. On the other hand, we analyze whether the distribution of feature points has obvious regularity, divide the image into blocks, and then count the probability of the occurrence of feature points in each block, that is, the number of feature points in the current block divided by the total number of feature points. For convenience, we divide the result by the maximum value in all the blocks, and we can find that the feature points are concentrated in the central region and the bottom. The probability of feature points appearing in the upper left and upper right corner is less.

## 2.4 Accelerated Feature Matching

Accelerated feature matching can be accelerated from two aspects, one is to reduce the scale of computation at the algorithm level, and the other is to use parallel hardware, such as multi-core processor, GPGPU or reconfigurable processor, to achieve acceleration. The main idea of software algorithm level optimization is to reduce the number of feature points extracted from each image under the condition of ensuring accuracy. Because if two images are matched in people's cognitive range, most of these images have far more matching points than reducing the number of feature points. Reducing the number of feature points per image will not affect the matching of most images. Therefore, reducing the number of feature points does not have much effect on the accuracy on the premise of maintaining the size of feature points. The commonly used

process is to detect the salient region of the image by using the image salient region detection algorithm, and then to extract the features from the salient region of the image. Combining these two methods to calculate the salient map of the original image and then to extract the feature from the region of the salient map not only reduces the number of feature points and speeds up the time of feature matching but also accelerates the time of feature extraction.

## 2.5 Area Feature Detection

An intelligent network weak coverage detection algorithm based on big data is based on the eigenvalue of Hessian matrix. For each point, the Hessian matrix is calculated. According to the Hessian matrix, a eigenvalue can be obtained, and the point with the largest eigenvalue in a certain region is selected as the feature point. We consider that the region with the most concentrated distribution of image feature points is the salient region of the image. The Hessian matrix can quickly calculate the matrix and the largest subregion, so the distribution matrix of the feature points can be transformed and then the suitable region can be calculated by using the Hessian matrix. An Intelligent Network weak coverage region Detection algorithm based on big data the box filter method is used to approximate the eigenvalues of the Hessian matrix. The formulas are as follows:

$$Det = D_{xx} * D_{yy} - 0.81 * D_{xy} * D_{xy} \quad (2)$$

$D_{xx}$ ,  $D_{yy}$ ,  $D_{xy}$  is the sum of the corresponding weights of each point in the corresponding box filter. When calculating  $D_{xy}$ , all white points have a weight of 1, a black weight of  $-1$  and a gray weight of 0. When calculating  $D_{yy}$ , the weight of white area is 1, the weight of black is  $-2$ , and the box filter corresponding to gray weight is  $90^\circ$  of box filter rotation of  $D_{yy}$ , the weight of white area is  $-1$ , black weight is 2, gray weight is 0. The sum of gray levels in each area can be calculated using the previously abstracted integral image. In this way, the eigenvalue  $Q$  can be easily calculated:

$$Q = (1 - A)x \quad (3)$$

Where  $A$  is a matrix and  $x$  is a set of all eigenvalues. In order to ensure that the extracted feature points are not affected by image size transformation, big data's intelligent network weak coverage region detection algorithm adopts pyramid method to solve this problem. For an image, it is first calculated for its views with different zoom sizes, each not small and of the same size, as a layer, called a scale, and several scale put together to form a octave, Several octave groups form a pyramid. In the pyramid of each image, each octave represents an image of different sizes, while several scale in each octave are called interval, and each interval calculates the eigenvalues with different box filter sizes.

In the pyramids, for each scale, the local largest point is found as the candidate feature point, that is, the point with the largest eigenvalue of the eight sampling adjacent points. After finding the candidate feature points, for each candidate feature point, in its corresponding octave, the points adjacent to the 26 points around it, that is,

the points on the cube centered on the candidate feature points, are compared, if the eigenvalues of the points are the largest. Then the candidate feature point is considered to be the feature point, otherwise it is not.

Finally, the corresponding position of the feature points in the original image is calculated from the feature points of the integral image.

## 2.6 Implementation of Weak Coverage Area Detection Algorithms in Intelligent Networks

The traditional weak coverage area detection algorithm in intelligent network firstly obtains three salient maps according to the brightness, color and direction characteristics of each pixel in the image, and then synthesizes three salient maps to generate salient areas of the image. After obtaining the salient region of the image, the local feature extraction algorithm is used to detect the feature points in the salient region, that is, the feature points with high contrast. Finally, the feature vectors of each feature point are calculated in the description stage. The weak coverage area detection algorithm based on large data in intelligent network assumes that the area with the most concentrated distribution of feature points in the image is the salient area of the image. In the processing of the algorithm, an adaptive matrix is generated according to the distribution of feature points in the image obtained during the feature detection stage, and then the maximum sub-matrix of the adaptive matrix, i.e. the region with the most concentrated distribution of feature points, is obtained by using the dynamic programming algorithm. The whole algorithm can quickly detect the salient area of the image with less loss to determine whether the area is the weak coverage area of the intelligent network. It reduces the computation of salient region detection algorithm while effectively reducing the feature information. The feature points detected by the weak coverage area detection algorithm of intelligent network based on large data are usually the dark spots in the bright spots or the bright spots in the dark spots in the image, and the salient areas of the image are the areas where the feature points are most distributed. Therefore, the problem of finding salient regions can be transformed into the problem of finding regions with the most concentrated distribution of feature points in images. In order to achieve the selection of salient feature regions, first of all, images need to be partitioned, and the information of feature points contained in each image sub-block is recorded in a matrix.

In order to find the region with the most concentrated distribution of feature points, we consider that we can use the algorithm of finding elements and the largest continuous region in the matrix. However, since the elements of the distribution matrix are natural numbers, the matrix needs to be processed to contain negative numbers.

For each image algorithm, we first need to get a feature point distribution matrix  $B$  of  $m*n$  according to its feature point distribution. The calculation process is divided into the following steps:

- (1) The coordinate position of the feature points can be obtained by detecting the feature points in the feature detection stage.

- (2) The image is segmented into  $m \times n$  blocks ( $m$  denotes the number of row blocks and  $n$  denotes the number of column blocks,  $m$  and  $N$  can be determined according to the actual situation);
- (3) According to the coordinate position information of feature points, the number of feature points in each block area is recorded as distribution matrix  $B$ .

After obtaining the distribution matrix  $B$  of the image, it is necessary to study whether the image has the characteristics of feature point set, that is, whether a region with an area ratio of  $X$  can be found in general images, and the percentage of feature points is  $y$  ( $x > y$ ). Among the 10,000 image samples, an average of 15.62% of the regions accounted for 27.22% of the features, and 36.75% of the regions accounted for 61.91 features. It shows that there are key areas in the image.

In order to obtain the region  $R$  with the most concentrated distribution of feature points in matrix  $B$ , the region  $R$  is defined as the largest sub-region in which the number of feature points per unit area is larger than the number of feature points per unit area in the whole image, generally  $P > 1$ . That is to say:

$$\max\{R \mid \frac{\sum_{i,j \in R} b[i][j]}{\sum_{i,j \in all} b[i][j]} \geq Q\} \quad (4)$$

Where  $b[i][j]$  represents the number of feature points in column  $j$  of row  $i$ .  $\sum_{i,j \in R} b[i][j]$  is the number of feature points contained in region  $R$ .  $\sum_{i,j \in all} b[i][j]$  is the number of feature points of the whole image.  $R$  is the area of region  $R$  and  $all$  is the area of the whole image.

Through the above process, we can find the largest sub-region with the most dense feature points, so as to realize the detection algorithm of weak coverage area in intelligent network based on large data, which provides a feasible experimental premise and basis for this method.

### 3 Experimental Results and Analysis

In order to ensure the effectiveness of weak coverage area detection algorithm in intelligent networks based on large data, simulation experiments are designed. In the process of experiment, the weak coverage area of an intelligent network is taken as the experimental object to detect the weak coverage area of the intelligent network. In order to ensure the effectiveness of the experiment, the traditional algorithm is compared with the algorithm in this paper, and the experimental results are observed. All possible sub-matrices of the matrix are traversed by using the weak coverage area detection algorithm of intelligent network. First, the starting and ending positions of rows are determined, then the starting and ending positions of columns are determined, and then the sum of the sub-rectangular regions is traversed. The complexity of the algorithm is  $O(m^3 * n^3)$ ,  $m$  for rows and  $n$  for columns.

In order to better compare the advantages and disadvantages of the algorithm, the simulation experiment uses the data set containing exception set A and B. Figure 3 is a comparison of abnormal location performance between traditional weak coverage area detection algorithm and large data-based weak coverage area detection algorithm in intelligent networks.

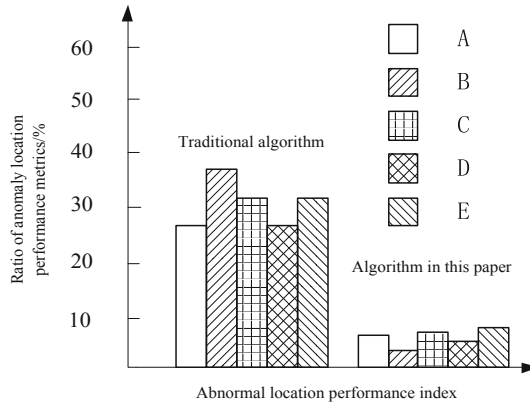


Fig. 3. Comparison of performance measures for anomaly localization

By comparing the performance of anomaly location between the traditional weak coverage area detection algorithm and the large-data-based weak coverage area detection algorithm, it can be seen that the probability of anomaly location of the large-data-based weak coverage area detection algorithm in intelligent network is much smaller than that of the traditional weak coverage area detection algorithm in intelligent network.

## 4 Concluding Remarks

Aiming at the problem of anomaly location which often occurs in traditional weak coverage area detection algorithm of intelligent network, a detection algorithm of weak coverage area of intelligent network based on large data is proposed. Firstly, the detection data are collected by the data acquisition method based on local features, and then the gray conversion of these detection data is used to realize the pre-processing and pre-processing detection of the detection data. The feature vectors are used to describe the feature points, and the accelerated feature matching of the detected data is realized. Then, the detected data are detected by region feature detection. Finally, an intelligent network weak coverage area detection algorithm based on large data is implemented. Weak coverage area detection algorithm based on large data in intelligent network achieves weak coverage area detection in intelligent network. It has smaller abnormal location probability and less computing overhead, and improves the detection rate of weak coverage area in intelligent network. By comparing the abnormal location

performance of traditional weak coverage area detection algorithm with that of the weak coverage area detection algorithm based on large data, experiments verify the detection performance of the weak coverage area detection algorithm based on large data in intelligent network. It can be seen that the abnormal location of the weak coverage area detection algorithm based on large data in intelligent network is abnormal. Bit probability is much less than the traditional weak coverage area detection algorithm.

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