UDC 621.391.14

A FAST FEATURE ERROR PATTERN GENERATING TWO-DIMENSIONAL ERROR PATTERNS

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Submitted March 27, 2020

Abstract. In this paper, after comprehensive analysing the existing method for forming feature error pattern, in which the types of two-dimensional vectors are allowed to determine. A fast feature error pattern generating algorithm is proposed by the idea that constructing other error patterns by using the simple or basic error pattern. This algorithm is faster than the previous algorithm theoretically.

Keywords: error pattern, two-dimensional vectors.

Introduction

In this paper, our research focused on the t byt matrix, in which there are only t elements are one. These elements can be called as point.The work is based on the generating of two dimensional error pattern whose generating process is very complex and consume much amount of time, in[3 – 6] method for generating complete point vectors was proposed, however, in which the computational complexity dramatically increased with the climbing of the order of t,so before processing the information, we need to reduce the pattern of point library in the initial stage.

The rest of the paper is organized as follows. In Section 2, a brief introduction of the classical method for classification numbers (points) will be presented. And in section 3, an improved algorithm which used to generate the patterns library has proposed. The conclusion will be given in Section 4.

The method for classification error patterns

On the basic of [1], our research focused on the t by t matrix, in which there are only t elements are one.In statistics, where classification is often done with logistic regression or a similar procedure.The most primitive method to generate all possible point patterns through an exhaustive search, the point pattern can be equivalent to a matrix which is *t* by *t* and the set of possible patternsare represented by $A_t = C_{t^2}^{t}$, As can be seen from A_t, when $t = 2$, we need to analyze 6 possible patterns, then when $t = 7$ – about 90 million,as t increases, the amount of calculation increases exponentially.Therefore, in the following work, without changing the complete library patterns, we will reduce the computational complexity by reducing the total number of patterns.

Algorithm forming the libarary patterns

In [1-5] we know that when $t = 2$ the set of point locations in the table consists of 6 differentcombinations.The number of point patterns depends on the number of random permutation characters.

According to the result we concluded that the structure of the patterns which can divide into two categories, the rank of the first type of matrix is less than *t*, the rank of the second type of matrix is equal to*t*, and then we can divide the first type into three structures. The shape formed by "1"has no intersections. The second is that the shape formed by the error pattern contains intersections. The structure of the patterns is shown inFig. 1.

At first, we need to calculate the rank of the matrix, if the rank of the calculated matrix equal t $(R_t = t)$, in the other word the matrix belong to the identity matrix,otherwise $R_t < t$ and we need toclassificate the structure of the matrix which rank is less than t.

The rule for forming the library of point patterns:

1. Calculation the rank of the basis pattern $t \times t$.

2.Analyzing the structure of the basic pattern $t \times t$.

3.According the structure of the basic pattern extension the patterns $(t+1)\times(t+1)$.

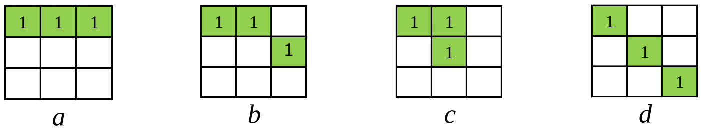

Fig. 1 The structure of the error patterns:
a,*b*– no intersection; *c*– intersection; *d* –diagonal

At the basic of the conclusion we classify the matrix whose rank less than *t*as two parts, one part as the Fig. 2 shows, there is no double linked points, in other words the coordinate of the point doesn't have the intersection, for example the pattern of 3.01 and 3.02 they don't have the intersected coordinate.

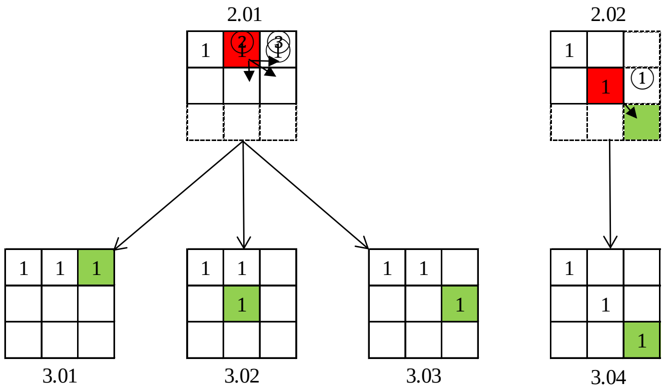

Fig. 2From patterns 2.01 and 2.02 obtain thepatterns of $t = 3$

After the above pre-processing process, we use the following rules to obtain the final reduced error pattern library:

According to the definition [2], the two matrices are equivalent if they can be transformed into each other through the transformation. Select any one of the equivalent matrices as a representative, indicating this type of point pattern. Rules can be expressed as follows:

The rule for creating the library of point patterns:

1. Calculate the total number for each string (*s*)and column (*c*) and sort the results by size.

2. Calculation of rank for each matrix.

3. Calculating the number of intersections by row and column.

4. Calculating the sum and difference of the intersection coordinates.

After we obtain those subsets which shown in figure 2, we need to calculate the transposition of them, from the 3.01,3.02 to 3.01^T and 3.02^T. It is clearly that the transposition of 3.04 is itself because 3.04 is anidentity matrix. Furthermore, the transposition of the pattern of 3.03 also has this special property here, although its transposition is not completely same as the original pattern, we also seem they are the same .This phenomenon is caused by the definition which mentioned in [2].

According to the results of the above analysis, for those patterns without intersection structure, the only need for us to get patterns mentioned in [1–5] is to around three positions add "1", right, lower and lower right position respectively. However, for those patterns with intersection structure, getting the wanted results, we need to add "1" in five different directions which presented in Fig. 3.

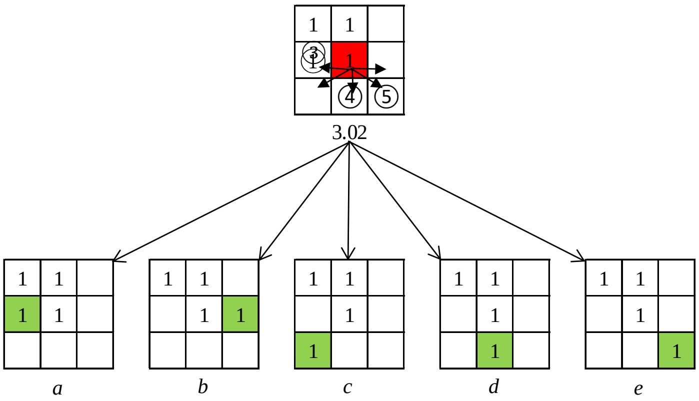

Fig. 3From pattern 3.02 obtain thepattern of $t = 4$

In this experiment, we add "1"to the patterns according to the rules mentioned above to produce other error pattern,which eliminate the redundant operations in [4–5]. The proposed algorithm can generate the $t+1$ order pattern from the*t* order pattern by using of the iterative methods.

Conclusion

In this paper, a fast feature error pattern generating algorithm has proposed which based on the existing simple two order error patterns to derive those error patterns with higher order or more complex. Our method has better performance when in terms of the speed when comparing with the generating algorithm which proposed in [3–5].Furthermore, the feature error pattern yielded by our algorithm is more intuitive, so it is easy to find out originate error pattern, which providing the shortcuts and theoretical base for identification in the future research.

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