THE OPTIMAL COMBINATION OF DITHER MATRIX BY USING GENETIC ALGORITHM

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Abstract: In this study, optimal combination of dither matrix is searched on a viewpoint of image quality with Genetic Algorithm(GA). At first, the combination of matrix is selected at random. The method of Crossover is interchanging positions of two individuals from element no.0 to element no. X. No. X is selected at random. And the type of selecting individuals is the tournament. The criterion of comparing data is cost E that is the evaluation value of gray level. And it is addition of cost Em and cost Ec. Individuals that have small cost E are prior carried over. The cost E of Bayer dither is 102.846. The cost E of GA is 102.826. It is clear that the result of GA is more super than Bayer dither on a viewpoint of image quality.

Keywords: GA, dither matrix, optimal combination, cost E, Tournament, One-pointed Crossover

I. INTRODUCTION

Nowadays, dither matrix which is four rows and four columns is used by newspaper, color photocopier and so on. The famous dither matrices are used in many situations. For example, Bayer method is one of famous methods. However, the study that these famous methods are really optimal combinations by viewpoint of optimization for combinations is not found. In this study, the matrix that has better evaluated value than existence matrices is searched for to enhance image quality. Its optimal combination is searched by GA.

II. ALGORITHM OF USING GA

In this study, individuals are themselves. Elements of individuals are threshold level of gray level from 0 to 255. The threshold levels are Equation.1. "I[x]" is position x of the matrix. "i" is numerical number from 0 to 15. The numeral numbers of elements of Table 1 are "i" of equation (1).

The same number is not set in the same individual. GA is to convert grouping and to search what combination of elements is the optimal combination. In this study, the operation of GA which Toshiharu[1] shows is as below.

(1) The matrices which have elements set in at random are prepared
(2) Set up solution of cost function E. Cost function E is the addition of cost Em and cost Ec. Cost Em is evaluated value of gray level. Cost Ec is Evaluated value of contrast. Equation of cost function E is as below.
(3) The individuals of next generation are decided by using the tournament method.
(4) Selecting two individuals and doing single point Crossover.
(5) Two elements of the individual which is selected at random are exchanged.
(6) Running over from (2) to (5) until the numbers of generations reach the generation number.

The number of individual is 200, the number of generation is 40, the probability of shakeout is 0.1 and the probability of mutation evolution is 0.01.

Single point Crossover is exchanging the position of elemental number from 0 to X of individual. The position of elemental number X is selected at random.

If the same elements are in the same individual, empty number of element sets one of duplicative element.

III. RESULT

The evaluated values of using GA and Bayer method which is the famous method are as below.

Fig.1 Em=6.7611,Ec=126.7910,E=102.7850

Fig.2 Em=6.8215,Ec=126.8531,E=102.8468

The lower cost E is, the matrix is optimal. Result of using GA is better than Bayer method. Ken-ichi [2] shows that the best of coefficients of cost Em and Ec are 0.2 and 0.8.

Because one pointed Crossover is more optimal than other methods, it is imagined that the sort of last individual of generation tends to live to be exchanging elements in group better than separately.

Even if generation numbers are over 40, the evaluated value is not good any more. As a result, it is assumable that the matrix of table1 is the optimal combination by the point of view of gray level.

IV. FIGURES/TABLES

1. Figures

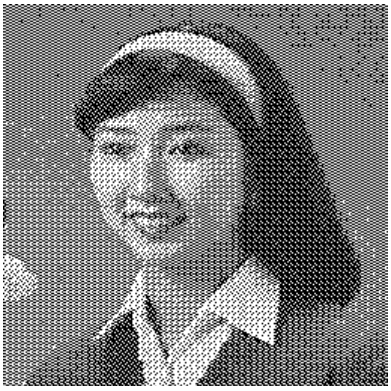

Fig1. The image using dither matrix searched by GA.

Fig2. The image using dither matrix of Bayer method.

2.Table

Table1. The matrix of using GA

7	11	0	8
3	13	6	15
9	2	10	4
12	5	14	1

3.Equation

$$I[x]= (2xi+1)x8 \quad (1)$$

$$E=0.2xEm+0.8xEc \quad (2)$$

x:times

IV. CONCLUSION

This matrix is gotten good evaluated value in color images. Therefore, if the optimal matrix is found by using GA, it will be used for many images.

In this study, parameters that are the individual number, the probability of mutation evolution and so on, are checked by hand. Therefore, it is unclear that these parameters are really optimal numerical number. For solving this problem, these parameters are become elements of GA. GA that has these elements is capable to search matrix that has better evaluated value than Figure1.

REFERENCES

[1] Toshiharu N (2002), Evolutionary Image Processing Publication Shoukoudou Inc.

[2] Ken-ichi T(2007), Color Images Halftoning Using Simulated Annealing. Publication The Journal of The Institute of Image Information and Television Engineers Vol.61, No.6, pp828-834.