ALGORITHMS FOR CONVERSION OF DIFFRACTIVE STRUCTURES INTO EXPOSITION DATA

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ABSTRACT

Algorithms designed for conversion of diffractive structures described by bitmaps into data for electron-beam lithograph BS600 are proposed in this article. The electron-beam lithograph BS600 is a world unique machine suitable for creating diffractive structures in resolution of 100 nm. Two algorithms were designed for conversion of diffractive structures of different nature.

1 INTRODUCTION

The work of the laboratory of Electron-Beam Lithography in the Institute of Scientific Instruments of Academy of Sciences of Czech Republic is focused to the development of diffractive structures. An electron beam lithograph BS600 is used. The electron beam lithograph BS600 was developed in the Institute of Scientific Instruments and improved in project ELITO. The format of the exposition data is language ASBEST [1]. The electron beam, generated by cathode, is cropped to a rectangular shape of a variable size. The limit of the lithograph is the time of the exposition because of fluctuation of parameters. The time of the exposition is dependent mainly on the speed of communication between the computer sending the exposition data and the microchip controlling the electromagnetic system of the lithograph. A way to minimize the count of instructions being sent is to minimize the count of elementary expositions. The optimal way of conversion of a diffractive structure to exposition data is dependent on the character of the diffractive structure.

2 CONVERSION ALGORITHMS

The first method proposed was developed for diffractive structures with almost straight lines. This method works in steps: 1. finding continuous line; 2. finding parts of the line of the same height (if the line is horizontal); 3. dividing found parts to sections of preferably same length. An example of input and output of the described algorithm is shown in Fig. 1. The output of this method can be improved by: 1. rearranging elementary expositions in the parts where lines divide; 2. the elementary expositions of the size smaller than chosen minimum can be removed; 3. the gaps caused by the removal of too small elementary expositions can be filled by extending the size of the neighbouring elementary expositions; 4. extended time of the exposition of smaller elementary expositions can be set.

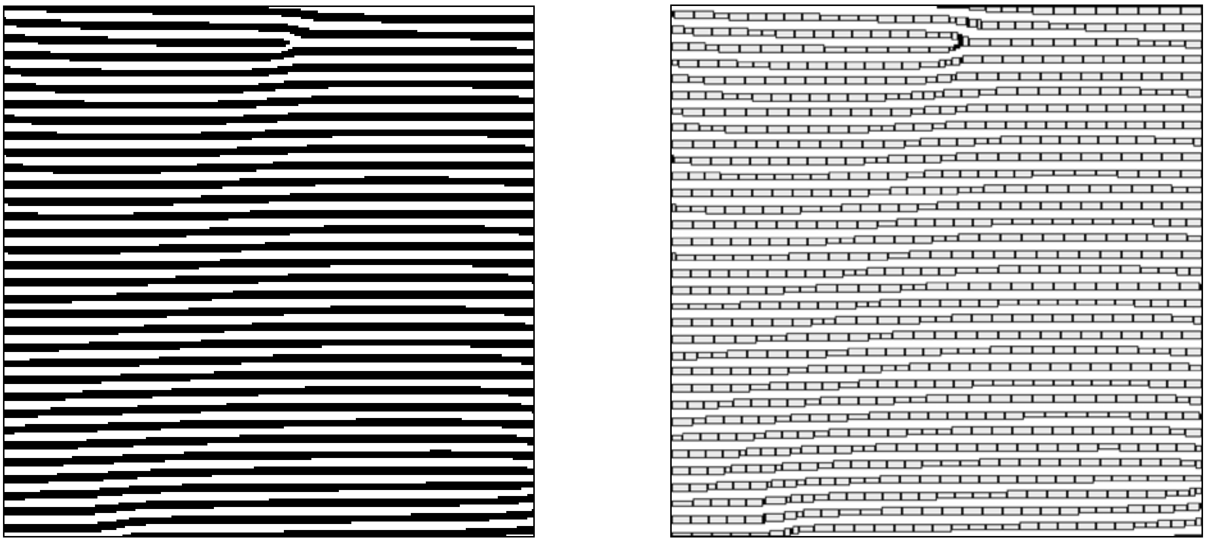

Fig. 1: *The input bitmap and simulated output of the first proposed algorithm*

The second method proposed was developed for diffractive structures of universal character. The method is based on locating the largest elementary exposition. The count of elementary expositions on the output of this algorithm has to be reduced. An example of input and output of this algorithm is shown in Fig. 2. The output of this method can be improved by rearranging elementary expositions in order to decrease the change of the deflection. Changes of the deflection, bigger than a limit, increase the exposition time, due to delay time for stabilisation of D/A converters controlling the deflection inductors.

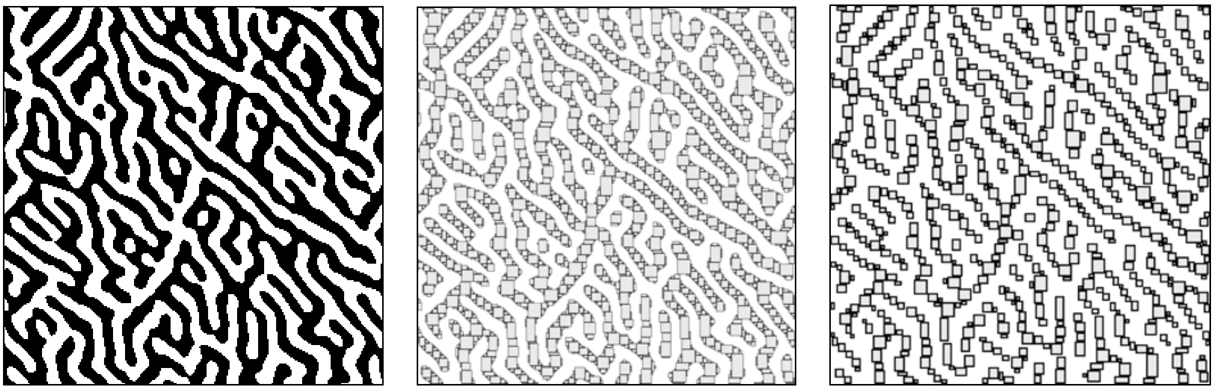

Fig. 2: *The input bitmap, output of the algorithm and ditto after removal of elementary expositions of the size smaller than a chosen minimum.*

The algorithm mentioned for rearranging the order of elementary expositions was realized in several versions based on two main ideas. The method of placing the elementary expositions into sections smaller than a chosen limit is simpler and faster than the second idea, which is based on placing the neighboring elementary expositions in sequence.

The second idea was improved by filling the gaps, after removal of elementary expositions smaller than a chosen limit, by extending the size of neighboring elementary expositions.

An algorithm, joining advantages of the algorithms described and extending the idea of filling gaps, was designed. The improvement of filling gaps is based on increasing the size of the elementary expositions to exceed the edge of the structure. The comparison of the results of the last two algorithms described is shown in Fig. 3.

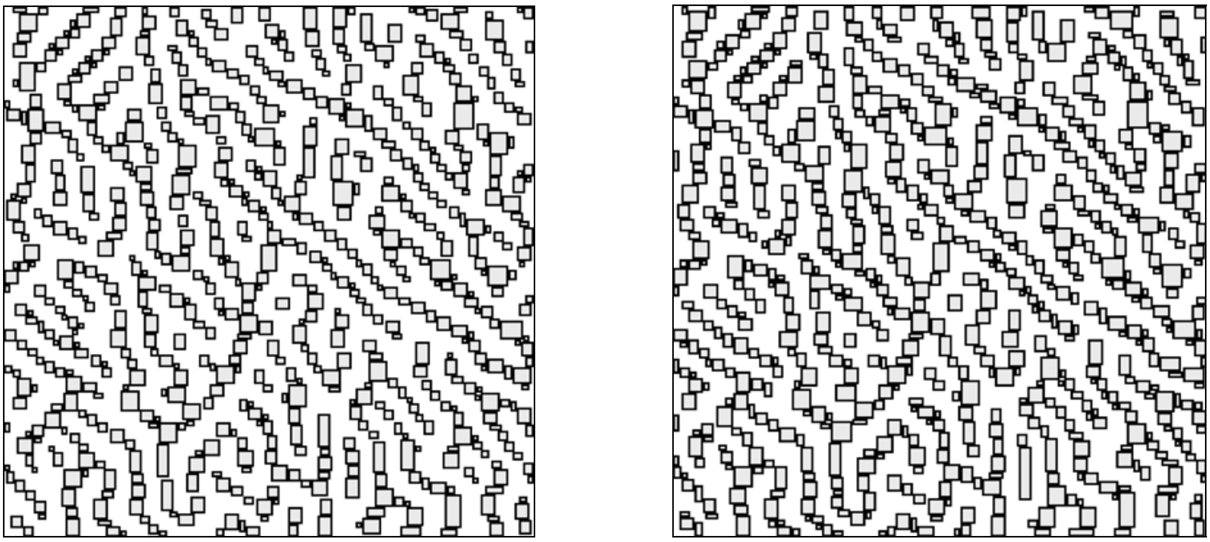

Fig. 3: *Result comparison of last two methods described*

3 CONCLUSION

Algorithms for conversion of diffractive structures to exposition data were designed. Different ways of reducing the count of the elementary expositions were used for different types of diffractive structures.

ACKNOWLEDGEMENT

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REFERENCES

[1] ELTEK s.r.o, Kroměříž: Syntax of the EXPO software version 1.4 [Help] 1998