Parallel Interpretation of Relaxation Method for Algebraic Image Reconstruction in Optical Tomographs

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Abstract - **We consider the parallel interpretation of relaxation method for algebraic reconstruction of tomographic images and a mathematical model of method parallel interpretation and its advantages over direct reconstruction methods.**

Keywords - **optical tomograph, algebraic reconstruction of images, parallel relaxation method interpretation**.

I. INTRODUCTION

In recent years, optical imaging methods, especially diffusion imaging [1], have the highest developing rate among the methods of medical diagnosis including diagnosis of breast cancer. However, the basic "load" is to restore information about the object internal structure. It falls on algorithms of "inverse" problem solving which are able to work in multiple scattering conditions.

Under these circumstances the role of the new approach [2, 3] based on the use of the parallel optoelectronic computer structures concept is raising. Its procedures and algorithms along with the traditional one's, turn up to be widely used methods of mathematical transformation and processing of incoming data arrays - oriented to natural parallelism vectors or matrices.

II. PARALLEL INTERPRETATION OF RELAXATION METHOD

Methods of algebraic reconstruction resolve themselves to solving systems of linear algebraic equations (SLAE). In the paper [2] it is proposed to use the parallel interpretation of Gauss-Jordan method to solve the tomography "inverse" problem ensuring the calculations execution time equal to $T = N$ steps. However, the accuracy of this method is usually less than the accuracy of iterative methods, and therefore a parallel interpretation of iterative relaxation method is considered.

The first phase includes forming a system suitable for iterative methods. To do this, we use logical matrix multiplication operations, duplicating of diagonal matrix elements to fit the line, formation of the vector-column from diagonal matrix elements and dividing two matrices. All matrix operations are performed simultaneously at all stages.

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The second stage includes a direct solving of the residual SLAE. To implement the necessary functions we put into action the $mx[]$ and the $mxNum[]$ operators. The first one finds the maximum vector element and the second one finds the maximum vector element index. With the $One[]$ operator we create a vector, which is made up of ones and its maximum element is made up with zero. Iterative process is continued until we reach the desired accuracy.

Time needed to resolve SLAE using the proposed parallel iterative method can be estimated by the following formula:

$$T_{total} = (8M^2 + 8MP + 38M + 18P + 121) \cdot k \cdot \tau_l , \qquad (1)$$

where M – number of mantissa numbers bit slices;
P – number of exponent bit slices;
τ_l – parallel logical multiplying time;
k – number of iterations.

III. CONCLUSIONS

Suggested parallel interpretation of relaxation method has advantages over the parallel interpretation of Gauss-Jordan method because unlike it, relaxation method in its parallel interpretation ensures the independence of operation performance time and the N input matrix and vector dimensions and thus provides the best time characteristics under multiple scattering conditions.

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