ABSTRACT

Now one of the main stages in the study of objects, phenomena and processes of different nature is mathematical modeling and related computer experiment. Numerous experiments give an opportunity to plan a full-scale experiment, as well as to get new knowledge about those processes and phenomena for which it is difficult, or in general, impossible to carry out a full-scale experiment. A large number of mathematical models can be described by systems of linear algebraic equations (SLRs) with soldered matrices after performing the corresponding transformations.

The main feature of such systems is their large orders and a small number of non-zero elements. Large orders of SLAR arise due to the fact that researchers want to get the most reliable results, which is why more detailed models are being built. The small number of non-zero elements is due to the discretization of the model. In particular, systems of equations with sparse matrices arise in problems of analysis of the strength of structures in civil and industrial construction, filtration, heat and mass transfer, and others like that. Scope of the methods of solving SLR with sparse matrices is constantly expanding. Because of this, there is an interest in the problem of constructing effective methods for solving such systems, whose orders exceed hundreds of thousands.

Classical results concerning the development of methods for solving SLRR with rarefied matrices are covered in a series of monographs of American and domestic authors: A. George, J. Liu, S. Pisanetski, J. Golub, R. Tjurson, I. A. Blatova, ME Ekseryrovskaya and others.

Also, the requirements for the computer technology used to conduct a computer experiment are growing. It must provide sufficient speed and have the required amount of resources so that the result of the experiment can be obtained over a relatively short period of time. Now in the market there are many different architectures of computers with parallel computing organization. The most productive are the platforms of the so-called "hybrid" architecture. These systems combine MIMD (multiple instructions - multiple data) and SIMD architecture (single instruction - multiple data), in particular, in a multi-core processor system,

computations are accelerated by means of a graphical accelerator. Hence, one of the effective approaches to solving SLR with sparse matrices is the construction of parallel algorithms that take into account the peculiarities of computer architecture.

The main problems of developing effective parallel algorithms are: analysis of the structure of the matrix, or bringing it to the corresponding form, using appropriate conversion algorithms; choice of effective data decomposition; determining the effective number of processor cores and graphic accelerators used for calculations; definition of the interprocess communication topology, which reduces the number of communications and synchronizations.

It is precisely for analyzing the structure of a sparse matrix that a neural network is used which allows the selection of groups of non-zero elements that can be processed independently. The results of the analysis will be based on the decomposition of data and the number of computing cores to be selected, which will provide the shortest settlement time for a particular matrix structure.

The purpose and objectives of the study. The purpose of the work is to develop and research parallel methods and computer algorithms for research and solving SLR with sparse matrices of irregular structure on computers of MIMD architecture and MIMD and SIMD architecture combinations, testing of algorithms in mathematical modeling in applied problems.

The research tasks include:

• development and research of iterative parallel algorithms for SLR with sparse matrices of irregular structure with approximate data;

• development of algorithms and programs for investigating the validity of solutions obtained by direct and iterative methods;

• Approbation of algorithms for mathematical modeling in applied problems.

The object of the study is the mathematical models described by SLAR with sparse matrices of the irregular structure.

The subject of the study is parallel methods and computer algorithms for locating the SLR solution with sparse matrices of the irregular structure.

Research methods. The paper uses methods of matrix theory, linear algebra, graph theory, functional analysis, error theory, and the theory of neural networks.

SLAR, PARALLEL CALCULATION, IMAGE RISK, NEURAL NETWORK, DATA CLASSIFICATION, NONZERO ELEMENTS