ABSTRACT

Master's Thesis: 103 pp., 18 figs., 24 tables, 1 appendix, 37 sources.

Actuality of theme. Now one of the main stages in the study of objects, phenomena and processes of different nature is mathematical modeling and the related computer experiment. Numerical experiments provide an opportunity both to plan a full-scale experiment and to gain new knowledge about those processes and phenomena that make it difficult or impossible to do a full-scale experiment. A large number of mathematical models after the corresponding transformations can be described by systems of linear algebraic equations (SLAE) with sparse matrices.

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. According to the results of the analysis, the algorithm will be selected, the data decomposition will be built and the number of computational nuclei will be selected, which will provide the shortest calculation time for a specific matrix structure.

The purpose and objectives of the study. The purpose of this work is to automate the design of building structures using a neural network, the study of parallel methods and computer algorithms for the study and solution of SLAR with sparse matrices of irregular structure, and the testing of algorithms in mathematical modeling in applied problems.

The goal is based on the development of original mathematical methods and parallel algorithms and their implementation in a special system that is designed to determine and analyze the strength of building structures.

Research objectives include:

- development of a neural network to determine the type of sparse matrix of irregular structure and to choose the optimal algorithm for solving SLAR;
- investigation of direct parallel algorithms for SLAR with sparse irregular structure matrices with approximate data;
- development of algorithms and programs for investigating the validity of the solutions obtained by direct and iterative methods;
- approbation of algorithms for mathematical modeling in applied problems.

The object of study is mathematical models that describe SLAEs with sparse matrices of irregular structure.

The subject of the study are parallel methods and computer algorithms for finding the SLAE solution with sparse matrices of irregular structure.

Research methods. The methods of matrix theory, linear algebra, graph theory, functional analysis, error theory, neural network theory are applied.

Scientific novelty: The scientific novelty of the results obtained is to improve the approach of solving the problem of determining the strength of structures by automating the process of selecting an efficient algorithm using a neural network, which significantly reduced the time to calculate the strength of the structure and optimization of computer resources.

Publications: Based on the dissertation materials, 3 scientific papers were published: 1 article and 2 abstracts at conferences.

SLAE, PARALLEL CALCULATION, IMAGE RECOGNITION, NEURAL NETWORK, DATA CLASSIFICATION, NON-ZERO ELEMENTS