

ABSTRACT

Explanatory note size – 174 pages, contains 13 illustrations, 18 tables, 3 applications, 52 references.

Topicality. Enterprises often face many computational tasks, the nature of which is multifaceted and diverse. Existing software products are either quite demanding on computer hardware resources, or they require staff training and have excessive functionality, or they are insufficient for solving many specific tasks in mechanical engineering. The standard capabilities of programming languages are often insufficient to operate with long numbers. This complicates the task of creating specific computational software products. In turn, numerical methods require the use of large-precision numbers and controlled calculation accuracy. In this regard, solutions that work with long arithmetic, providing support for calculations with a virtually unlimited number of digits, are particularly relevant. Some tools are not optimal in terms of performance or have limited functionality. There is a need for software that can efficiently solve computational problems with adjustable precision.

The aim of the study: to improve the performance, efficiency, and usability of software tools for performing engineering and scientific calculations in the field of mechanical engineering.

The object of research: software for performing engineering and scientific calculations.

The subject of research: models for building software for performing engineering and scientific calculations in the field of mechanical engineering, long arithmetic algorithms and methods for testing them.

To achieve the stated goal, the **following tasks** have been formulated:

- to create software for solving certain computational problems in mechanical engineering, in particular, calculating the weight of rolled metal, the weight or length of a wire, the breaking force and diameter of a rope;
- develop own solutions in the field of long arithmetic: functions for performing basic arithmetic operations, as well as generators of random extra-long integers

- and fractional numbers in a given range or with a given length, create solutions for generating and calculating random mathematical expressions with extra-long numbers;
- check the speed and prove the accuracy of the calculation results;
 - perform a comparative analysis of the effectiveness of your own solutions with the popular GNU Multiple Precision Arithmetic Library, using MPIR and MPFR forks;
 - using third-party libraries, create a more accurate analogue of a software tool for calculating the power of an extra-long number;
 - solve the problems of cross-platform compatibility and integration of our library into other software products.

The scientific novelty of the results of the master's thesis lies in the fact that the absence of errors in our own implementation of solutions based on long arithmetic was ensured by formalised methods of verifying the correctness of calculations. A method of combined functional and performance testing of various libraries for working with computational tools was proposed, resulting in new experimental data on performance comparison. A comprehensive approach to the implementation of long arithmetic in multiple number systems was developed. The architecture for integrating the computational core with subject-oriented calculation modules and the methodology for developing industry-oriented computational systems with open architecture have been further developed.

The practical value of the results obtained lies in the fact that the created software product contributes to increasing the productivity of engineers and reducing production costs, it reduces the need for more complex solutions, it is scalable, and contains functions for regulating accuracy and proving the correctness of the calculation results.

Relationship with working with scientific programs, plans, topics. The work was performed at the Department of Informatics and Software Engineering of the National Technical University of Ukraine «Kyiv Polytechnic Institute. Igor Sikorsky».

Approbation. The scientific provisions of the dissertation were tested at the state-owned enterprise '61 Communards Shipbuilding Plant' (the part of the Ukroboronprom concern), as confirmed by the relevant certificate of implementation.

Keywords: LONG ARITHMETIC, GMP, RANDOM NUMBERS, NUMBER SYSTEMS, ENGINEERING CALCULATIONS, MACHINE BUILDING, ROPE, METAL ROLLING