

- of national and local development*] (pp. 29-33). Poltava: PNPU imeni V. H. Korolenka [in Ukrainian].
- Mar'ienko B. S. (1996). Psykholohichni aspekty politychnoi identyfikatsii [Psychological aspects of political identification]. In *Naukovi studii iz sotsialnoi ta politychnoi psykholohii [Scientific studies in social and political psychology]* (Vol. 2 (5). pp. 64–69). Kyiv [in Ukrainian].
- Mintc S. S. (1989). O vozmozhnom podkhode k izucheniiu sotcialnogo soznaniia v istoriko-kulturnykh issledovaniiah (postanovka problemy) [On a possible approach to the study of social consciousness in historical and cultural research (problem statement)]. In *Matematicheskie metody i EVM v istoriko-tipologicheskikh issledovaniiah [Mathematical methods and computers in historical and typological studies]* (p. 219). Moskva: Nauka [in Russian].

УДК 519.25:004

orcid.org/ 0000-0003-2876-9316

orcid.org/ 0000-0001-5192-9918

ЯНКО Аліна Сергіївна

кандидат технічних наук, доцента кафедри комп'ютерної інженерії Полтавського національного технічного університету імені Юрія Кондратюка

КРАСНОБАЄВ Віктор Анатолійович

доктор технічних наук, професор кафедри електроніки та управляючих систем Харківського національного університету імені В.Н. Каразіна

METHODS AND TOOLS FOR FAST AND RELIABLE PROCESSING OF INTEGER DATA OF STATE INFORMATION SYSTEMS USING A NON-POSITIONAL NUMBER SYSTEM IN THE RESIDUAL CLASSES SYSTEM

A characteristic feature of an industrial society is the development and use of new, progressive information technologies based on the widespread use of superproductive and reliable dual-use computer systems and components (CSC). The development and improvement of over-productive and reliable dual-purpose CSC is a strategically important and topical issue and is under the special control of the heads of states and governments of the advanced countries of the world. Today, there are a number of areas of science and technology, where there is a need for fast, reliable and high-precision integer arithmetic calculations: arithmetic operations on integers and polynomials; integer linear programming; operations on numbers and sets; solution of multidimensional NP-complete problems; implementation of routing algorithms; multiplication of vectors and matrices; the problem of the Fourier transform and its application;

neural network data processing systems; tasks for military purposes; digital signal processing; digital image processing; cryptographic transformations; highly-precise integer arithmetic; the solution of problems related to the space research; highly-precise digital-to-analog and analog-to-digital conversions (Krasnobayev, Koshman, & Mavrina, 2014, p. 969).

The results of research in the field of the creation of high-speed CSIDPMs of well-known authors (Valakh M., Svoboda A., Sabo N., Aksushskiy I.Y., Yuditskiy D.I., Glushkov V.M., Torgashov V.A., Amberbaev V.M., Kolyada A.A., Shimbo A., Paulier P., Thornton M.A., Dreschler R., Miller D.M., and others) showed that the use of RCS as a system of calculations of CSIDPMs, intended for the implementation of integer arithmetic operations of addition, subtraction and multiplication numbers in the positive numerical range, significantly increases the speed of the solution of problems of a certain class. In recent years, the following CSIDPMs have been developed in the RCS: On-board computer Star (USA); specialized DFT processors (USA, South Korea); a number of military specialized on-board computers (USA, Japan); specialized DSP processors (USA); Sprint Computers for Robotics (USA, Japan); in the Chinese company «Tpv Display Technology (Wuhan, China) Co., Ltd» in the development and implementation of a wireless sensor network monitoring system for industrial equipment in the manufacture of monitors; at the enterprise «Relcom-Podillya Ltd.» in developing the system of video surveillance on the basis of wireless multimedia sensor networks; at «Cypress Semiconductors Corporation» in developing hardware software for CY8CKIT-050 PsoC 5 and CyFi (CYRF7936) modules that can be used in wireless sensor networks (Amir Sabbagh Molahosseini, Leonel Seabra de Sousa, & Chip-Hong Chang, 2017, p. 111).

The aim of the project is to increase the efficiency (performance) of dual-use CSC and the reliability of the processing of integer data by developing and implementing methods for monitoring, diagnosis and correction of errors in the RCS. The basis of the project is the principles of data processing in the RCS. It is also possible to increase the productivity of the CSC and the reliability of processing integer data based on the use of new machine arithmetic. In the positional numeral system (PNS), the execution of an arithmetic operation involves the sequential processing of the digits of operands according to the rules determined by the content of the operation, and can not be completed until the values of all intermediate results are sequentially determined taking into account all the connections between the digits. Thus, PNSs, in which information is presented and processed in modern computers, have a significant drawback - the presence of inter-bit relations, which impose its imprint on the methods of implementing arithmetic operations, complicate the equipment and limit the speed. Therefore, it is natural to look for possibilities of using such arithmetic, in which there would be no queuing connections. In this regard, the system of calculus in the residual classes draws attention to itself. The system of residual classes has a valuable property of the independence of the residuals

from each other on the basis of the adopted system. This independence offers wide opportunities for constructing not only new machine arithmetic, but also a fundamentally new scheme for the implementation of CSC, which in turn significantly expands the use of machine arithmetic. The numerical system to a greater extent affects the structure of the operating unit (OU) of the CSC.

The use of expected results will increase the level of national state security in the information sphere by formulating, developing and refining the principles, modern technologies, models, methods, algorithms and means of fast and reliable processing of integer data. The introduction of methods, algorithms and tools for fast and reliable processing of integer data will improve the efficiency of the use of both modern general purpose CSC and double-use CSC. Computer systems and components operating in the SSC should be implemented at the national and international levels when used in the defense sector, the banking sector, public administration, and production. The practical value of the expected results is as follows: practical increase of indicators of efficiency of functioning of computer systems and dual-purpose networks (Torgashov, 1973, p. 64).

The introduction of the theoretical and practical results will contribute to the creation, development and operation of high-performance CSC with increased reliability of data processing. The methodological basis for building a CSC in the RCS involves a comprehensive solution to the problem of increasing the productivity and integrity of the processing of integer data, as well as providing information security, impedance, performance and durability of the functioning of computer systems and components. The expense of the corresponding state budget funds is justified by significant reduction of further expenses with the maximum return from the latest digital technologies, and the introduction of high-speed computer systems and components (Akushsky, & Yuditsky, 1968, p. 16).

Implementation of the applied research project and the implementation of the results will facilitate the introduction of the latest high-speed computer systems and tools in Ukraine, as well as information exchange technologies in existing and future TCS, including dual-use systems, which are subject to increased requirements for the confidentiality, integrity of data, impedance and secrecy of system operation. The results of the work will have a significant impact on the competitiveness of domestic developments in the field of development of high-speed CSC of special purpose.

The value of the expected results of an applied research project is to develop new, relevant, scientifically-based results. The principles formulated and the methods of data processing developed in the RCS are of great importance for the development of the theory and practice of creating and using a high-speed, reliable and reliable dual-purpose CSC. The use of CSC that possess these properties is particularly relevant and important in the conduct of information and hybrid wars (Shu, Wang, & Wang, 2016, p. 4).

The value of the expected results for the training of specialists in the education system, particularly the ones of the higher qualification, is to gain

deep theoretical knowledge and practical skills in the field of developing and implementing information and computer systems and technologies, as well as in developing the theory and practice of creating overproductive and reliable CSC, based on the application of RCS. In addition, it is known that the development and improvement of overproductive, credible and reliable specialized dual-purpose CSC is a strategically important and topical issue and is under the special control of the heads of states and governments of the advanced countries. The value of the expected results for the training of specialists in the education system is also mastering the methodology of scientific and pedagogical activities with the conduct of its own scientific research within the framework of the implementation of scientific-technical objectives of the project.

References

- Akushsky I. Ya., & Yuditsky D. I. (1968). *Mashinnaia arifmetika v ostatochnykh klassakh* [Machine arithmetic in residual classes]. Moscow: Soviet radio [in Russian].
- Amir Sabbagh Molahosseini, Leonel Seabra de Sousa, & Chip-Hong Chang (2017). *Embedded Systems Design with Special Arithmetic and Number Systems*. Cham, Switzerland: Springer International Publishing.
- Krasnobayev V. A., Koshman S. A., & Mavrina M. A. (2014). Metod povysheniia nadezhnosti proverki dannykh, predstavlenykh v sisteme schisleniia ostatkov [A Method for Increasing the Reliability of Verification of Data Represented in a Residue Number System]. *Kibernetika i sistemnyi analiz* [Cybernetics and Systems Analysis], 50, 6, 969-976. DOI: 10.1007/s10559-014-9688-3 [in Russian].
- Shu S., Wang Y., & Wang Y. (2016). A research of architecture-based reliability with fault propagation for software-intensive systems. In *2016 Annual Reliability and Maintainability Symposium (RAMS)* (pp. 1-6). Tucson, AZ.
- Torgashov V. (1973). *Sistema ostatochnykh klassov i nadezhnost tsifrovyykh kompiuterov* [System of residual classes and reliability of digital computers]. Moscow: Sov. Radio. [in Russian].