Applied problems of information systems operation

UDC 681.142 **doi: 10.20998/2522-9052.2021.1.18**

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THE DATA DIAGNOSTIC METHOD OF IN THE SYSTEM OF RESIDUE CLASSES

Abstract. The **subject** of the article is the development of a method for diagnosing data that are presented in the system of residual classes (SRC). The **purpose** of the article is to develop a method for fast diagnostics of data in the SRC when entering the minimum information redundancy. **Tasks**: to analyze and identify possible shortcomings of existing methods for diagnosing data in the SRC, to explore possible ways to eliminate the identified shortcomings, to develop a method for prompt diagnosis of data in SRC. **Research methods**: methods of analysis and synthesis of computer systems, number theory, coding theory in SRC. The following **results** were obtained. It is shown that the main disadvantage of the existing methods is the significant time of data diagnostics when it is necessary to introduce significant information redundancy into the non-positional code structure (NCS). The method considered in the article makes it possible to increase the efficiency of the diagnostic procedure when introducing minimal information redundancy into the NCS. The data diagnostics time, in comparison with the known methods, is reduced primarily due to the elimination of the procedure for converting numbers from the NCS to the positional code, as well as the elimination of the positional operation of comparing numbers. Secondly, the data diagnostics time is reduced by reducing the number of SRC bases in which errors can occur. Third, the data diagnostics time is reduced due to the presentation of the set of values of the alternative set of numbers in a tabular form and the possibility of sampling them in one machine cycle. The amount of additionally introduced information redundancy is reduced due to the effective use of the internal information redundancy that exists in the SRC. An example of using the proposed method for diagnosing data in SRC is given. **Conclusions**. Thus, the proposed method makes it possible to reduce the time for diagnosing data errors that are presented in the SRC, which increases the efficiency of diagnostics with the introduction of minimal information redundancy.

Keywords: number system; system of residue classes; operational data diagnostics; non-positional code structure; computer system; computer component.

Introduction

A foundation of some modern specialized informational and telecommunication systems is based on computer systems (CS) of handling of integer data, represented in non-positional notation in residue classes (SRC). In this case, one of the main ways of achieving high effectiveness of functioning of telecommunication systems while handling integer data in real-time is an improvement, firstly, such features of CS in SRC as reliability and performance of data handling.

It is known, that usage of such features of SRC as independence, rights equality, and low-discharge of residues $\{a_i\}$ defining non-positional code structure (NCS) of data $A_{SRC} = (a_1 \| a_2 \| ... \| a_{i-1} \| a_i \| a_{i+1} \| ... ... \| a_n \| ... \| a_{n+k})$ provides high user performance of implementing in CS calculation algorithms, which consist of a set of integer arithmetical operations. The largest effectiveness of SRC usage can be achieved in case if implemented algorithms consist of a set of such arithmetical operations as addition, multiplication, and subtraction [1, 2]. On the other hand, a necessity of providing fault-tolerant functioning of CS in SRC requires the development and deployment of methods of quick control, diagnostic, and data error correction, which are different from methods, used in regular binary positional notations (PN) [3-5]. Thus, researches, devoted to the development and improvement of quick (operative) methods of diagnostic of errors of data in CS, functioning in SRC, are important and relevant.

The aim of the article is the development of the method of quick diagnostic of data in SRC while entering minimal informational redundancy.

Main part

In the general case, the diagnosis of data in SRC is being understood as a process of defining distorted residues in NCS as $A_{SRC} = (a_1 \| a_2 \| ... \| a_{i-1} \| a_i \| \| a_{i+1} \| ... \| a_n \| ... \| a_{n+k})$, where n and k are quantity of informational and control bases m_i $(\mathrm{i} = \overline{1, n+k})$ in ordered $(m_i < m_{i+1})$ SRC, correspondingly. The diagnostic of NCS is being performed after the data control for further probable error correction. In the article, the method of data diagnostic in the case of entering minimal ($k = 1$) informational redundancy is considered. The minimal code distance equals two. The method is based on the concept of an alternative number set and on the usage of features of NCS in SRC [5]. Due to those the procedure of increasing informativeness of AS in SRC is developed.

1. The method of diagnostic of non-positional code structures in the system of residue classes Consider the method of NCS diagnostic, based on obtaining additional information about probably distorted residues of incorrect number $\tilde{A}$. This information is contained in all possible AS of number $\tilde{A}$. Let SRC is specified by ordered ($m_i < m_{i+1}$) bases $m_1,...,m_{n+1}$. And let an incorrect number $\tilde{A}$ is defined in the process of calculations. For increasing informativeness about placement and error measure, it is suggested to additionally define AS of number as

$$W_{k_{\rho_i}}\left(\tilde{A}\right)=\left\{m_{k_1},m_{k_2},\ \dots\ ,m_{k_{\rho_i}}\right\},$$

i.e. set AS:

$$W_{1_{\rho_1}}\left(\tilde{A}\right)=\left\{m_{11},m_{12},\ \dots\ ,m_{1_{\rho_1}}\right\};$$

$$W_{2_{\rho_2}}\left(\tilde{A}\right)=\left\{m_{21},m_{22},\ \dots\ ,m_{2_{\rho_2}}\right\};$$

. . . .

$$W_{n+1_{\rho_{n+1}}}\left(\tilde{A}\right)=\left\{m_{n11},m_{n12},\ \dots\ ,m_{n+1_{\rho_{n+1}}}\right\}. \quad (1)$$

Tentatively calculate the value of the interval $(j+1)$ of the number $\tilde{A}$ occurrence in order to define the set of values (1)

$$j_k=\bar{m}_k\cdot\gamma_k\left(\bmod m_k\right), \quad (2)$$

for $k=\overline{1,n+1}$. Also, due to value $k=n+1$ the $W_{n+1_{\rho_{n+1}}}\left(\tilde{A}\right)$ equals $W_{n+1_{\rho_{n+1}}}\left(\tilde{A}\right)=W\left(\tilde{A}\right)$. According to (2) the formation of k tables is performed, where values γ_k are matched against Δa_i. After defining AS $W_{k_{\rho_i}}\left(\tilde{A}\right)$, which called primary ASs, the secondary ASs is defined as vectors, components of which are possible values of errors Δa_i as:

$$W_1^{(1)}\left(\tilde{A}\right)=\left\{\Delta a_1^{(1)},\Delta a_2^{(1)},...,\Delta a_{n+1}^{(1)}\right\},$$

$$\dots$$

$$W_1^{(\psi_1)}\left(\tilde{A}\right)=\left\{\Delta a_1^{(\psi_1)},\Delta a_2^{(\psi_1)},...,\Delta a_{n+1}^{(\psi_1)}\right\};$$

$$W_2^{(2)}\left(\tilde{A}\right)=\left\{\Delta a_1^{(2)},\Delta a_2^{(2)},...,\Delta a_{n+1}^{(2)}\right\},$$

$$\dots$$

$$W_2^{(\psi_2)}\left(\tilde{A}\right)=\left\{\Delta a_1^{(\psi_2)},\Delta a_2^{(\psi_2)},...,\Delta a_{n+1}^{(\psi_2)}\right\};$$

and so on to value of vectors in the form of:

$$W_n^{(\psi_n)}\left(\tilde{A}\right)=\left\{\Delta a_1^{(\psi_n)},\Delta a_2^{(\psi_n)},...,\Delta a_{n+1}^{(\psi_n)}\right\},$$

and completely to value of vector as: $W_{n+1}(\tilde{A}) = \{\Delta a_1, \Delta a_2, \dots, \Delta a_{n+1}\}$.

Components of the vector $W_{n+1}(\tilde{A})$ are compared to according components of all vectors $W_i^{(\psi_i)}\left(\tilde{A}\right)$ for $i=\overline{1,n}$. The matching the measure components of vectors are chosen and the bases of SRC are defined, and their set defines resulted AS in the form of

$$W'\left(\tilde{A}\right)=\left\{m_{z_1},m_{z_2},\ \dots\ ,m_{z_\rho}\right\}.$$

Indeed, among AS $W_{k_\rho}\left(\tilde{A}\right)$ there is always a basis m_i, which gives an error Δa_i, and that basis can be only among bases, which are common for the set (1)

$$W\left(\tilde{A}\right)\geq W'\left(\tilde{A}\right). \quad (3)$$

When an Δa_i has such value, that number A starts to belong to the interval, then an equation is fulfilled

$$W\left(\tilde{A}\right)=W'\left(\tilde{A}\right). \quad (4)$$

where $M=\prod_{i=1}^{n} m_i$ and $M_1=M\cdot m_{n+1}$.

Thus, the idea of suggested method lays in the following: all possible ASs are defined on each of the intervals of number A occurrence. After this, the common for these intervals bases $m_{z_1},\ \dots\ ,m_{z_\rho}$, which possibly give errors, are defined. That set of bases define sought AS. The reduction of the number of bases in AS increases informativeness of AS $W\left(\tilde{A}\right)$ about place and measure of error. It decreases the time of reducing AS to incorrect basis (the number of steps of tentatively AS defining is decreasing) and increases operability of diagnostic of data in SRC. The structure scheme of the process of AS reduction is presented on fig.1.

2. Geometrical model of the procedure of the increasing as informativeness. The geometrical model of the suggested method should be considered. The defining of number $(j+1)$ of the interval of distorted number $\tilde{A}$ occurrence, which is influenced by error Δa_i, is equivalent to the shift of this number in the interval $\left[j\frac{M_i}{m_i},(j+1)\frac{M_1}{m_1}\right)$ to the left to value $j\frac{M_1}{m_1}$. Decompose numerical sequence to corresponding intervals with length: $\frac{M_1}{m_1}$, $\frac{M_1}{m_2}$, …, $\frac{M_1}{m_{n+1}}$.

Define the numbers of intervals $(j+1)$, in which there is an operand $\tilde{A}$ on each of numerical segments as

$$T_{j_1}=\left[j_1\frac{M_1}{m_1},(j_1+1)\frac{M_1}{m_1}\right);$$

$$\dots\dots \quad (5)$$

$$T_{j_{n+1}}=\left[j_{n+1}\frac{M_1}{m_{n+1}},(j_{n+1}+1)\frac{M_1}{m_{n+1}}\right).$$

Defining the primary ASs (1) corresponds to defining the intervals numbers (5).

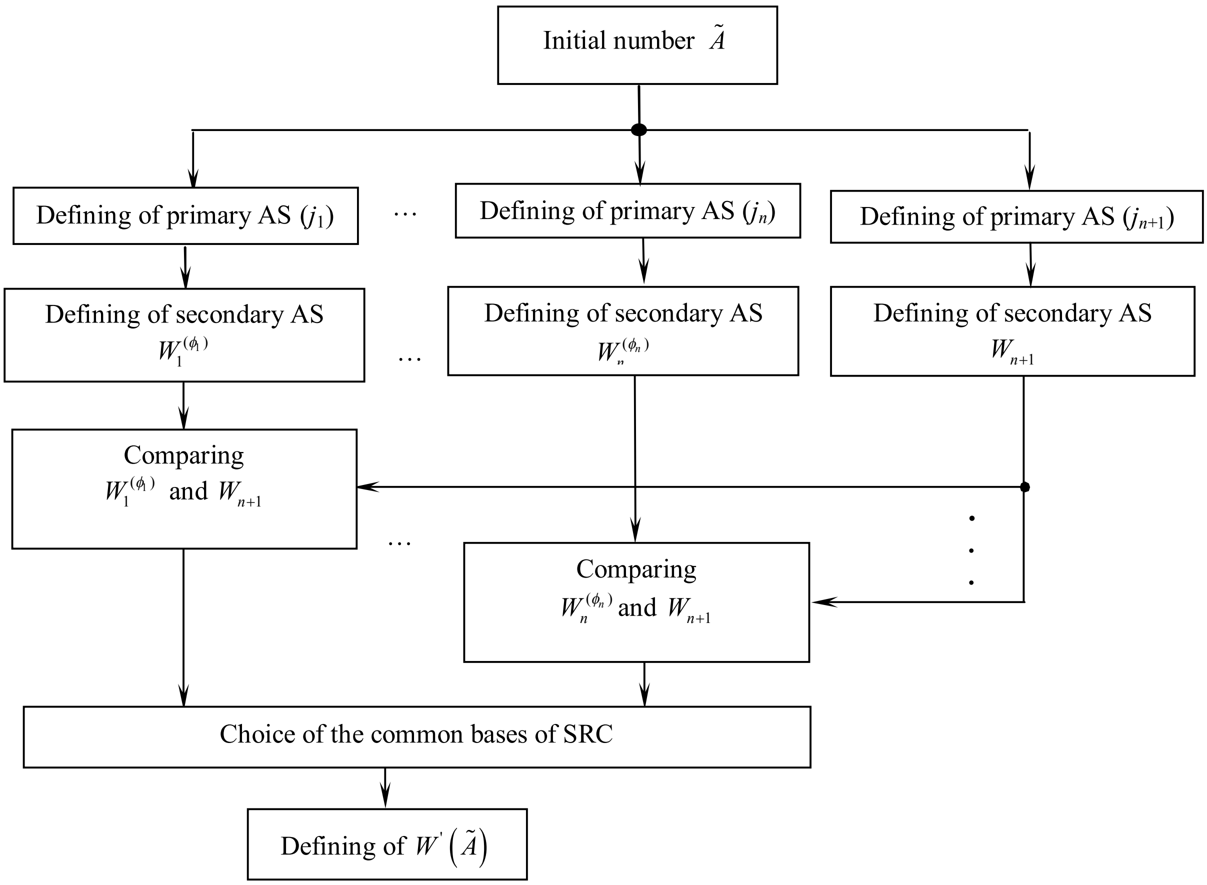

Fig. 1. Scheme of choice of bases in the alternative set of numbers in SRC

Defining the secondary AS $W'(\tilde{A})$ geometrically correspond to defining the interval $[z_1, z_2]$, where

$$z_1 = \max \in j_i \frac{M_1}{m_i}; \qquad z_2 = \min \in (j_i + 1)\frac{M_1}{m_i},$$

i.e. sought interval is being defined as intersecting of intervals sets (5)

$$T_{W'(\tilde{A})} = T_{j_1} \wedge T_{j_2} \wedge \ldots \wedge T_{j_{n+1}}.$$

It is obvious, that

$$z_2 - z_1 = \frac{M_1}{M_{n+1}}. \qquad (6)$$

Condition (6) is equivalent to condition (3). If error moves operand $\tilde{A}$ to interval $[(m_{n+1}-1), M, M_1]$, then

$$z_2 - z_1 = \frac{M_1}{m_{n+1}} = M. \qquad (7)$$

Condition (7) is equivalent to condition (4).

The suggested geometrical model confirms the correctness of the method's mathematical description, and also more clearly demonstrates the idea of the procedure of informativeness AS increasing or the reduction of the numerical interval of distorted number $\tilde{A}$ occurrence.

Consider an example of defining AS of number $\tilde{A}$ according to developed method. There is SRC with bases $m_1 = 2$, $m_2 = 3$, $m_3 = 5$.

The code words of this SRC are presented in the table 1.

Table 1. **The set of code words**

A **in PN**	m_1	m_2	m_3	A **in PN**	m_1	m_2	m_3
0	0	0	0	15	1	0	0
1	1	1	1	16	0	1	1
2	0	2	2	17	1	2	2
3	1	0	3	18	0	0	3
4	0	1	4	19	1	1	4
5	1	2	0	20	0	2	0
6	0	0	1	21	1	0	1
7	1	1	2	22	0	1	2
8	0	2	3	23	1	2	3
9	1	0	4	24	0	0	4
10	0	1	0	25	1	1	0
11	1	2	1	26	0	2	1
12	0	0	2	27	1	0	2
13	1	1	3	28	0	1	3
14	0	2	4	29	1	2	4

Thus,

$$M = 2 \cdot 3 = 6,\ M_1 = M \cdot 5 = 30,$$

$$m_{n+1} = m_3 = 5,\ A = (0,2,2),\ \Delta A = (0,2,0).$$

Assume, that after the influence of a single error

$$\Delta A = (0,0,...,\Delta a_i,...,0)$$

by i-th basis ($\Delta a_2 = 2$) there is a number

$$\tilde{A} = A + \Delta A = (0,2,2).$$

In order to define the set of primary ASs it is needed to tentatively define values j_k. For this the nuvelization of a number $\tilde{A}$ accordingly to the tables of nuvelization constants (table 2-4) is performed.

After this there are $\gamma_1 = 1,\ \gamma_2 = 1,\ \gamma_3 = 2$.

The set of primary ASs is defined as

$$W_{1\rho_1}(\tilde{A}) = \{m_2, m_3\},$$

$$W_{2\rho_2}(\tilde{A}) = \{m_1, m_3\}\Delta A = (0,0,...,\Delta a_i,...,0),$$

$$W_{3\rho_3}(\tilde{A}) = W(\tilde{A})^{-}\{m_1, m_2, m_3\}.$$

Table 2 – **Nuvelization constants ($m_1 \to m_2$)**

m_1	m_2
(1, 1, 1)	(0, 1, 4) (0, 2, 2)

Table 3 – **Nuvelization constants ($m_1 \to m_3$)**

m_1	m_3
(1, 1, 1)	(0, 0, 1) (0, 2, 2) (0, 0, 3) (0, 1, 4)

Table 4 – **Nuvelization constants ($m_2 \to m_3$)**

m_2	m_3
(0, 1, 0) (1, 2, 0)	(1, 0, 3) (0, 2, 2) (1, 1, 1)

The set of secondary ASs is defined by the tables 5-7, which are formed by values j_n:

for $\gamma_3 = 2$, $W_3(\tilde{A}) = \{1,1,2\}$;

for $\gamma_2 = 1$, $W_2^{(1)}(\tilde{A}) = \{1,0,2\}$; $W_2^{(2)}(\tilde{A}) = \{0,0,3\}$;

for $\gamma_1 = 1$, $W_1^{(1)}(\tilde{A}) = \{0,2,3\}$; $W_1^{(2)}(\tilde{A}) = \{0,0,4\}$.

Table 5 – **Secondary Ass (γ3)**

γ_3	Possible values of errors	$W_i^{(\Psi i)}$
0	none	–
1	$\Delta a_2 = 1$, $\Delta a_3 = 1$	$W_3^{(1)}(\tilde{A}) = \{0, 1, 1\}$
2	$\Delta a_1 = 1$, $\Delta a_2 = 1$, $\Delta a_3 = 2$	$W_3^{(1)}(\tilde{A}) = \{1, 1, 2\}$
3	$\Delta a_1 = 1$, $\Delta a_2 = 2$, $\Delta a_3 = 3$	$W_3^{(1)}(\tilde{A}) = \{1, 2, 3\}$
4	$\Delta a_2 = 2$, $\Delta a_3 = 4$	$W_3^{(1)}(\tilde{A}) = \{0, 2, 4\}$

Table 6 – **Secondary Ass (γ2)**

γ_2	Possible values of errors	$W_i^{(\Psi i)}$
0	$\Delta a_3 = 1$	$W_2^{(1)}(\tilde{A}) = \{0, 0, 1\}$
1	$\Delta a_1 = 1$, $\Delta a_3 = 1$, $\Delta a_2 = 1$,	$W_2^{(1)}(\tilde{A}) = \{1, 0, 2\}$, $W_2^{(2)}(\tilde{A}) = \{0, 0, 3\}$
2	$\Delta a_3 = 4$	$W_2^{(1)}(\tilde{A}) = \{0, 0, 4\}$

Table 7 – **Secondary Ass (γ1)**

γ_1	Errors	$W_i^{(\Psi i)}$
0	$\Delta a_2 = 1$, $\Delta a_3 = 2$, $\Delta a_3 = 1$	$W_1^{(1)}(\tilde{A}) = \{0, 1, 1\}$, $W_1^{(2)}(\tilde{A}) = \{0, 0, 2\}$
1	$\Delta a_2 = 2$, $\Delta a_3 = 3$, $\Delta a_3 = 3$	$W_1^{(1)}(\tilde{A}) = \{0, 2, 3\}$, $W_1^{(2)}(\tilde{A}) = \{0, 0, 4\}$

Implementation of choice of common SRC bases is suitable in the form of tables (tables 8), where sign "+" means match of the components of secondary ASs, and sign "-" means mismatch. Those tables show, that vectors components match in the bases m_1, m_3, i.e. the sought AS is as

$$W_3(\tilde{A}) = \{m_1, m_3\} \text{ (table 8, a).}$$

Therefore, $W(\tilde{A}) > W'(\tilde{A})$. Thus, the increase of the informativeness about error placement in the distorted number $\tilde{A}$ is guaranteed by the described method.

Table 8 – **Choice of common SRC**

a

m_1	m_2	m_3
1	1	2
1	0	2
+	-	+

b

m_1	m_2	m_3
1	1	2
0	0	3
-	-	-

c

m_1	m_2	m_3
1	1	2
0	2	3
-	-	-

d

m_1	m_2	m_3
1	1	2
0	0	4
-	-	-

In the geometrical interpretation example for given SRC is represented in the following way (Fig. 2).

The segment $[0,30)$ is decomposed to according numerical intervals $[15,30)$, $[10,15)$ and $[12,18)$.

Define numbers of intervals, in which an operand $\tilde{A}=(1,2,2)$ placed:

$$T_{j_1}=[15,30),\qquad T_{j_2}=[10,20),$$

$$T_{j_3}=[12,18).$$

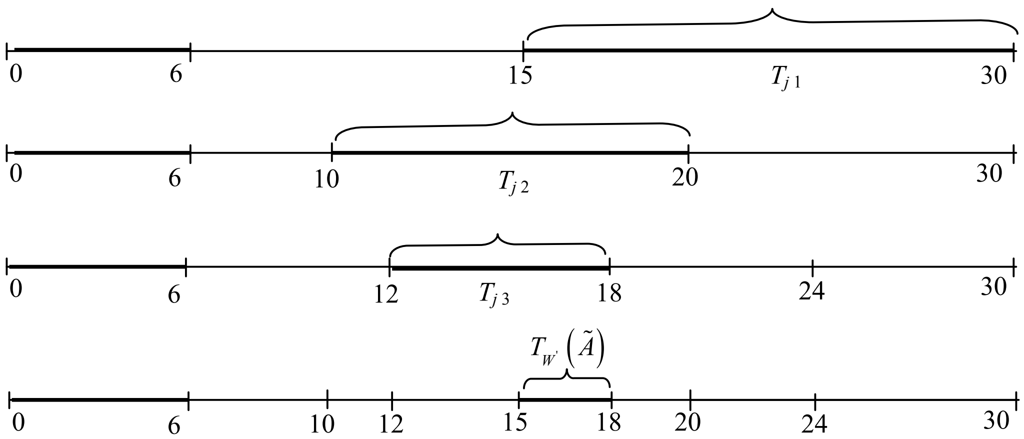

Fig. 2. Scheme of the defining a sought interval

A sought interval is defined by expression $T_{W'}(\tilde{A})=[15,18)$. It is obvious, that interval $T_{W'}(\tilde{A})$ is being reduced, compared to T_{j_3}, by three units (by 50%), and that leads to a decrease of the quantity of options of possible errors. Geometrical interpretation confirms the effectiveness of the considered method of data in SRC diagnostic.

Conclusion

Thus, the suggested method allows decreasing the time of diagnostic of errors of data, represented in SRC, which increases diagnostic operability. A reduction of the quantity of bases in AS increases informativeness AS about error placement and measure. It decreases the time of AS reduction to incorrect bases (the number of steps of tentatively AS defining is decreasing). The usage of the suggested method of operative diagnostic of data increases the total effectiveness and feasibility of using non-positional code structures in SRC in computing systems.

The time of data diagnostic, compared to known methods, is decreasing firstly due to excluding the procedure of transforming numbers in SRC to positional notation as in known methods, i. e. eliminating a positional operation of numbers comparing. Secondly, the time of data diagnostic is decreased by reducing the quantity of SRC bases, which are giving the possibility of mistake. Thirdly, the time of data diagnostic is decreased due to the usage of tabular sample value of an alternative set (AS) of numbers in SRC in one beat.

Therefore, the suggested method allows reducing the time of diagnosis of data errors in NCS, represented in SRC, which is increasing the diagnostic operability while entering minimal informational redundancy. Geometrical model of the procedure of AS informativeness increasing and specific example of usage of the suggested method of diagnostic of data in SRC confirms its practical feasibility.

The most effective way of the method usage is in the computational chain, which does not allow perform all planned procedures to AS reduction to the incorrect basis, i.e. in a quite long chain of calculations of CS.

References

1. Krasnobayev, V.A., Kuznetsov, A.A., Koshman, S.A. and Kuznetsova, K.O. (2020), "A method for implementing the operation of modulo addition of the residues of two numbers in the residue number system", *Cybernetics and Systems Analysis*, Vol. 56, No. 6, pp 1029-1038, DOI: https://doi.org/10.1007/s10559-020-00323-9.
2. Krasnobayev, V.A. and Koshman, S.A. (2018), "A method for operational diagnosis of data represented in a residue number system", *Cybernetics and Systems Analysis*, Vol. 54, Issue 2, pp. 336-344, DOI: https://doi.org/10.1007/s10559-018-0035-y.
3. Krasnobayev, V.A., Yanko, A.S. and Koshman, S.A. (2016), "A Method for arithmetic comparison of data represented in a residue number of system", *Cybernetics and Systems Analysis*, Vol. 52, Issue 1, pp. 145-150, DOI: https://doi.org/10.1007/s10559-016-9809-2.
4. Krasnobayev, V.A. and Koshman, S.A. (2019), "Method for implementing the arithmetic operation of addition in residue number system based on the use of the principle of circular shift", *Cybernetics and Systems Analysis*, Vol. 55, Issue 4, pp. 692-698, DOI: https://doi.org/10.1007/s10559-019-00179-8.
5. Krasnobayev, V.A., Koshman, S.A. and Mavrina, M.A. (2014), "A method for increasing the reliability of verification of data represented in a residue number system", *Cybernetics and Systems Analysis*, Vol. 50, Issue 6, pp. 969-976, DOI: https://doi.org/10.1007/s10559-014-9688-3.

Received (Надійшла) 15.11.2020
Accepted for publication (Прийнята до друку) 20.01.2021

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Метод діагностики даних у системі залишкових класів

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Анотація. **Предметом** статті є розробка методу діагностики даних, які представлені в системі залишкових класів (СЗК). **Метою** статті є розробка методу швидкої діагностики даних у СЗК при введенні мінімальної інформаційної надмірності. **Задачі**: провести аналіз і виявити можливі недоліки існуючих методів діагностики даних у СЗК, дослідити можливі шляхи усунення виявлених недоліків, розробити метод оперативної діагностики даних у СЗК. **Методи** дослідження: методи аналізу і синтезу комп'ютерних систем, теорія чисел, теорія кодування у СЗК. **Отримані наступні результати**. Показано, що основним недоліком існуючих методів є значний час діагностики даних при необхідності введення значної інформаційної надмірності у непозиційну кодову структуру (НКС). Розглянутий у статті метод дозволяє підвищити оперативність процедури діагностики при введенні у НКС мінімальної інформаційної надмірності. Час діагностики даних, в порівнянні з відомими методами, скорочується в першу чергу за рахунок усунення процедури перетворення чисел з НКС у позиційний код, а також усунення позиційної операції порівняння чисел. По-друге, час діагностики даних скорочується за рахунок зменшення кількості базисів СЗК, в яких можуть виникнути помилки. По-третє, час діагностики даних скорочується за рахунок представлення набору значень альтернативної сукупності (АС) чисел у табличному вигляді та можливості вибірки їх за один машинний такт. Кількість інформаційної надмірності, що додатково вводиться, зменшується за рахунок ефективного використання внутрішньої інформаційної надмірності, яка існує у СЗК. Наведено приклад використання запропонованого методу діагностики даних у СЗК. **Висновки**. Таким чином, запропонований метод дозволяє скоротити час діагностики помилок даних, що представлені у СЗК, та підвищує оперативність діагностики при введенні мінімальної інформаційної надмірності.

Ключові слова: система числення; система залишкових класів; оперативна діагностика даних; непозиційна кодова структура; комп'ютерна система.

Метод диагностики данных в системе остаточных классов

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Аннотация. Предметом статьи является разработка метода диагностики данных, которые представлены в системе остаточных классов (СОК). **Целью** статьи является разработка метода быстрой диагностики данных в СОК при вводе минимальной информационной избыточности. **Задачи**: провести анализ и выявить возможные недостатки существующих методов диагностики данных в СОК, исследовать возможные пути устранения выявленных недостатков, разработать метод оперативной диагностики данных в СОК. **Методы исследования**: методы анализа и синтеза компьютерных систем, теория чисел, теория кодирования в СОК. **Получены следующие результаты**. Показано, что основным недостатком существующих методов является значительное время диагностики данных при необходимости введения значительной информационной избыточности в непозиционную кодовою структуру (НКС). Рассмотренный в статье метод позволяет повысить оперативность процедуры диагностики при введении в НКС минимальной информационной избыточности. Время диагностики данных, по сравнению с известными методами, сокращается в первую очередь за счет исключения процедуры преобразования чисел из НКС в позиционный код, а также исключения позиционной операции сравнения чисел. Во-вторых, время диагностики данных сокращается за счет уменьшения количества базисов СОК, в которых могут возникнуть ошибки. В-третьих, время диагностики данных сокращается за счет представления набора значений альтернативной совокупности (АС) чисел в табличном виде и возможности выборки их за один машинный такт. Количество дополнительно вводимой информационной избыточности уменьшается за счет эффективного использования внутренней информационной избыточности, существующей в СОК. Приведен пример использования предложенного метода диагностики данных в СОК. **Выводы**. Таким образом, предлагаемый метод позволяет сократить время диагностики ошибок данных, которые представлены в СОК, что повышает оперативность диагностики при введении минимальной информационной избыточности.

Ключевые слова: система счисления; система остаточных классов; оперативная диагностика данных; непозиционная кодовая структура; компьютерная система.