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## EXPANDING THE POSSIBILITIES OF INSTRUMENTS TO IMPROVE THE INFORMATION RELIABILITY OF ELECTRONIC DOCUMENTS OF INDUSTRIAL MANAGEMENT SYSTEMS

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**Abstract.** The possibilities of tools to increase the reliability of the transmission of electronic documents in industrial control systems for use in various subject areas of data processing optimization are explored and expanded. A semantic search hyperset was designed, a software and algorithmic complex was implemented, which demonstrated an improvement in the reliability of information compared to existing technologies.

**Keywords.** electronic document, structural and technological redundancy, reliability, reference verification, image, signal characteristics, lexicological synthesis, document structure.

### Introduction

Analysis of modern scientific literature has shown that, despite the widespread use of existing service technologies, the issues of ensuring the reliability of information of electronic documents that are one of the key factors for improving the quality of data transmission and processing are not sufficiently resolved [1-4]. The absence of specialized software products, effective tools that perform the functions of optimizing the reliability of the transmission and processing of electronic documents creates additional difficulties and reduces the quality of the functioning of organizational management systems in different subject areas [3, 4].

The demand for research results is especially high in conditions when the functions of servicing a large flow of tasks in electronic documents are performed, various data formats are set, the

parameters of transient processes for the transmission and processing of electronic documents in real time are simulated, the efficiency criteria are optimized in the presence of hard-to-see and poorly formalized relationships between structural elements of service documents [5, 6].

In this regard, the study and solution of the following problems are justified: the analysis of known works, software technologies and products with the aim of selecting the direction of a new specific study on the problem of increasing the reliability of e-documents information on the basis of methods and algorithms for data mining (DM); the development of a software and algorithmic complex focused on increasing the reliability of information based on search, recognition and classification, control of the authenticity of requisites, attributes, e-documents formats for the purpose of detecting and correcting distortions.

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classification, control of the authenticity of requisites, attributes, and formats of electronic documents with the purpose of detecting and correcting distortions.

### **1. The main features of the software and algorithmic complex of increasing the reliability of information**

The complex of methods and algorithms for data processing implemented solutions for the following tasks [7].

- construction of computational schemes for simplified identification, approximation of transient processes of signal characteristics of frames of electronic documents.

- optimization of distribution and fixing of flows in accordance with the tasks of processing e-documents, the possibility of computing resources, the load of composite program modules, priorities, restrictions on the processing time and the execution of organizational and administrative documents.;

- development of methods for detecting and correcting distorted information, ensuring the reliability, integrity and security of e-documents.;

- modeling and identification of an information sequence of data processing tasks, the formation of a database and base of knowledge base;

- the description of relationships between characteristics, requisites, attributes and other elements of e-documents and the construction of algorithms for searching, recognizing, controlling the reliability and setting parameters of the model describing the transient processes of the signal characteristics of image frames;

- design of the semantic hypernet of search, analysis, processing of e-documents.

The software and algorithmic complex (SAC) includes the following modules:

- integrator - tools for setting, merging, importing, exporting data;

- semantic synthesizer, text analyzer and tools for generating e-documents;

- an adapter built on the basis of methods and algorithms for data mining;

- data loading interface, keyword libraries and dictionaries;

- converter is a data converter;

- distributor of movement of organizational and administrative documents on tasks.

in the start the program-algorithmic complex, the input is a disparate version of e-documents, a library of classes and programs for e-documents, tasks for processing e-documents, the final format for representing a template. Input e-documents are represented in the form of records, the components of which are divided into a specified number of fields.

### **2. Hypersemantic Network**

The semantic hypernet performs functions of searching for the necessary element of e-documents, analyzing the relationships between them, which is built on the basis of the synthesis of models of stochastic search, fuzzy logic, methods of formation and rules of use, knowledge base of fuzzy rules and database, as well as reflecting the functional relationships of variable inputs and outputs with Using the function of the accessories of linguistic terms. To optimize the learning of the semantic search hypervisor, rational training sets are formed, reductions of redundant links between the constituent components of e-documents and inefficient fuzzy rules in the knowledge base are produced.

Algorithms to ensure the reliability, integrity and safety of information are based on a comparison of the convergence of the search component of e-documents with the same or similar reference form, which are located in the database, and the necessary properties and characteristics of them in the knowledge base. To perform the search function, pictures of links between the components of e-documents in the following levels are reflected:

- on the first, pictures of connections between e-documents are reflected;

- in the second, the relationship between the attributes of e-documents are reflected;

- in the third, the links between the features of e-documents are reflected;

in the fourth, the rules of control of the reliability, integrity and safety of information are reflected;

in the fifth, the connections of the inputs and outputs of the fuzzy semantic hypernet (FSH) will be reflected;

in the sixth, the output layer of the network is located to make decisions about the reliability of e-document information.

To speed up the search function in a FSH environment, algorithms for parallel processing of data are synthesized, and the efficiency of the network is estimated by the parallelization coefficient  $k_i$ .

A frame-based variant of representing e-document image scenarios is proposed and implemented, which uses the basic template for storing the following frames [8]:

$$M_i^{U_i}; \hat{O}_{S_i}^{U_1 \leftrightarrow U_{1+n}} \text{ and their elements } - M_{i,j}^{Pic}.$$

The frame template should reflect the formed logical and structural relationships between the elements of e-documents, their properties, the number of levels, and the program modules involved in the following form

$$M_i^{U_i} \in [U_{1 \rightarrow n} \in (S_{1 \rightarrow m})],$$

where  $M_i^{U_i}$  - array of extracted and specified properties of e-documents;  $U_i$  - level of links between components of e-documents;  $S_i$  - components of e-documents belonging to the level of FSH;  $i$  - search counter for e-document elements;  $n$  - number of FSH levels;  $m$  - number of components of e-documents.

The implemented software and algorithmic complex (SAC) for ensuring the integrity, safety and reliability of information also includes the following software modules:

- the menu of programs, schedules of processes of the analysis and processing of e-documents;
- generation, analysis, synthesis, translation of e-documents;
- performing the functions of parameter settings and integration with other modules;

- computational schemes of structural components of FSH based on modules using the properties of fuzzy identification algorithms;

- control of frames of e-documents, detection and correction of errors.

It is proved that the FSH allows integrating the functioning of all program modules, the database and the knowledge base, performing data processing with the issuance of recommended solutions, and provides an accelerated search, creates conditions for the effective use of other modules, and organizes control over the reliability of e-document information.

### 3. Analysis of the efficiency of the SAC for increasing the reliability

A method has been developed and implemented in which many tasks of increasing the reliability of information of e-documents that are used to

evaluate results according to a certain "rating"  $r_{run}$ . For this purpose, a set of  $n$  jobs is formed and the job  $J_{run}$  with the highest rating is selected. The value of  $n$  is determined by the following condition

$$n = \begin{cases} N, & \text{if } n_{run} = 0; \\ \min\{n_{run}, N, M\}, & \text{if } n_{run} > 0. \end{cases} \text{ Where}$$

$N$  - total number of tasks;  $M$  - number of data processing modules in the complex;  $n_{run}$  - integer parameter of the module.

It is required to determine the execution time of a job package with length  $p.l$  on the set of  $C \in j.C$  according to

$$\mathcal{G} = (j.f) \cdot \mu \cdot (p.l) / c.r,$$

where  $(j.f) \cdot \mu$  - average execution time of the complex on a standard processor;  $c.r$  - performance of the complex.

It is assumed that the time  $\mathcal{G}$  from the set  $j.C$  is the same for all modules.

Limitations on packet sizes are imposed on the basis of following condition

$$1 \leq p.l \leq c.v.$$

Variations of possible values of  $\mathcal{G}$  are verified by following condition

$$(j.\mu) \cdot \max_{c \in C} (1/(c.r)) \leq \mathcal{G} \leq (j.\mu) \cdot \min_{c \in C} ((c.v)/(c.r)).$$

By denoting the left and right sides of the inequality, respectively, by  $m$  and  $M$ , we obtain following

$$\mathcal{G} = m + k_{check}^1 M,$$

where  $k_{check}^1 \in [0,1]$  - parameter of module.

The packet size is determined by fixing the value of  $\mathcal{G}$  from the specified range

$$p.l = \mathcal{G} \cdot (c.r) / ((j.f) \cdot \mu).$$

The parameter  $\mathcal{G}$  is considered to be the main one for setting up the complex in the environment of the e-document system.

$$j.t_{check} = k_{check}^2 \mathcal{G},$$

where  $k_{check}^2 \in [0,1]$  - parameter of the module.

To evaluate the effectiveness of the software-algorithmic complex, it is also necessary to determine the following parameters.:

$x_1(t)$  - number of modules involved by the time  $t$ , when the e-documents were distorted information;

$x_2(t)$  - the number of modules involved by the time  $t$ , when there was no distortion of information in e-documents;

$x_3(t)$  - the total number of modules involved at time  $t$ ;

$x_4(t)$  - the number of modules involved at time  $t$ , in which no errors in the information.

Functional efficiency of the SAC in the structure of  $S$  modules will be written as following

$$\omega(S) = \sum_{i=1}^4 c_i \lim_{T \rightarrow \infty} T^{-1} \sum_{t=0}^T E_S x_i(t),$$

where  $E_S$  - Operator of averaging of efficiency of all involved modules  $S$ ;  $S$  - specified structure of the involved modules of the complex;  $c_i$  - weighting factors that meet the criteria for estimating the minimum probability of undetected

errors, the “cost” and “laboriousness” of various data processing algorithms.

Achieving the goal reduces to finding the minimum of the objective function based on the criteria adopted method works simplexes  $S$ . Accordingly, the following adaptive strategy for optimizing the functional.

Let  $s_p$  be a probability distribution on the set of values of the parameter  $S = \{s_p, p \in P\}$ . The choice of the parameter  $p$  is realized as the realization of a random variable with distribution  $s_p$ . The strategy  $S$  is represented as a vector in a finite-dimensional space.

In many cases of practice, a gradient optimization method is used to minimize the function  $\omega(S)$  on the set  $S$ .

However, the implementation of such a method is associated with great difficulties of a computational nature and the impossibility of obtaining an explicit analytic representation of the function  $\omega$  and its derivatives. Instead of the exact value of the gradient of the function, it is recommended to use its evaluation based on the results of observations on the simulated process trajectory. A proposed algorithm which performs in conditions of minimal a priori information on the basis of a stochastic model with a partially observable Markov chain.

An experimental study was conducted and, following the results of the SAC implementation:

- the algorithm of adaptive optimization allows to obtain a stable value of the strategy (point) from the set  $S$  up to the third sign;

- The probability of choosing the values of the parameters  $S_{adap}$  is estimated by the best and worst strategies  $S_{max}$  and  $S_{min}$ .

- The spread between the best and worst strategies obtained by accidental searches turned out to be quite large;

- the target function and other parameters of the complex proved to be sensitive to the tuning of any of the six selected parameters of the models

describing the transient processes with fixed values of the others;

– the implementation of the random search method when optimizing the functional takes an order of magnitude longer and yields worse results than the adaptive strategy based on stochastic models with a partial Markov chain.;

– the strategy  $S_{adap}$  obtained as a result of the implementation of the adaptive algorithm turned out to be an interior point in the set  $S$ .

The proposed approach to the solution of the optimization problem is justified, since the imitation of transient processes of signal characteristics of transmitted frames of e-documents on the basis of the stochastic Markov model becomes significantly controlled by means of the selected settings.

In the table 1, the indicators for evaluating the effectiveness of the SAC for optimizing the reliability of e-document processing are conducted.

### Conclusion

Methodical bases for the implementation of the software and algorithmic complex for increasing the reliability of the transmission and processing of information of e-documents and the methods for integrating the program modules of the complex in a fuzzy semantic hypernet environment are developed. A stochastic model is proposed and special constructions of the language of interacting successive processes are used to simulate the processes of transmission and processing of signal characteristics of frames of images of e-documents.

Table 1.

The results of optimizing the reliability of e-document processing on the basis of the software and algorithmic complex

Strategy	Rating of the result by objective function	Rating (%) of the result by objective function	Rating (%) of the result by objective function	Rating (%) success in completing tasks e-document system	Losses, %
$S_{adap}$	37,76	67,49	32,51	94,58	3,22
$S_{max}$	42,09	68,75	31,25	96,71	5,39
$S_{min}$	25,40	48,15	51,85	68,41	31,55

It is established that the applied tools for describing simulations (DS) have such advantages as compactness and clarity, convenience for translation into computer code, the possibility of transformation and development of the model.

The scope of the proposed methodology is not limited to a specific example of the problem of ensuring the reliability of the transmission and processing of e-documents, and in the same way, optimizing methods for a variety of production systems can be constructed.

### REFERENCES

1.M.G.Konovalov, "Metody' adaptivnoy obrabotki informatsii i ix prilozheniya" [Methods of adaptive information processing and development Its application], Moscow: IPI, 2007, 212 p. (in Russian)  
 2.K.T.Leondes, "Fil'tratsiya i stoxasticheskoe upravlenie v dinamiceskix sistemax"[Filtering and statistical control in dynamic systems], Pod red. Moscow: Mir, 1980, 407 p.

3. V.J.Mathews, "Polynomial signal processing", V.J.Mathews, G.L.Sicuranza. A.Wiley Interscience publication, 2000, 452 p.  
 4. W.K.Ling, "Nonlinear digital filters: analysis and applications", W.K.Ling. Academic Press, 2007, 216 p.  
 5. A.V.Kolesnikov, I.A.Kirikov, "Metodologiya i texnologiya resheniya slojny'x zadach metodami funktsional'ny'x gibridny'x intellektual'ny'x sistem" [Methodology and technology of analysis of solving complex problems using functional hybrid intelligent systems], Moscow: IPI RAN, 2007, 387 p. (in Russian)  
 6. Uskov A.A. "Intellektual'ny'e tehnologii upravleniya" [Intelligent management technologies], Iskusstvenny'e neyronny'e seti i nechetkaya logika A.A. Uskov, A.V.Kuz'min. M.: Goryachaya liniya Telekom, 2004, 143 p.  
 7. I.I.Jumanov, Z.T.Bekmurodov, "Povy'shenie tochnosti obrabotki danny'x nestatsionarny'x ob'ektov na osnove optimizatsii nabora parametrov gibridnoy modeli identifikatsii" [Improving the accuracy of data processing of non-stationary objects based on optimization of a set of parameters of the hybrid identification model], XII Mejdunarodnaya Aziatskaya shkolaseminar «Problemy' optimizatsii slojny'x sistem», 12-16 dekabr 2016, Novosibirsk. pp. 192-201. (in Russian)  
 8. S.B.Pel'sverger, "Algoritmicheskoe obespechenie protsessov otsenivaniya v dinamiceskix sistemax v usloviyax neopredelennosti" [Algorithmic support of estimation processes in dynamic systems under conditions of uncertainty], M.: Nauka, 2004, 116 p. (in Russian)