DESIGN FEATURES OF THE INFORMATION TECHNOLOGY FOR THE LABOR MIGRANTS GROUP STRUCTURE DETERMINATION (p. 4-8)

Oksana Mulesa

The necessity of solving poorly structured and unstructured tasks in dealing with complex scientific and technical problems causes the need for developing relevant models, methods, and software. The task of the labor migrants group structure determination is faced by experts in the field of HIV/AIDS prevention and treatment in the process of investigating behavioral risks of the target group representatives.

In the paper, the verbal and mathematical formulation of the labor migrants group structure determination problem as the fuzzy clustering problem based on the assumption of a simultaneous object belonging to different clusters was performed. To solve the problem, it was proposed to use the adapted fuzzy c-means method based on the representation of non-numeric values by linguistic variables. This has allowed to find the distance between objects, the attribute vectors of which have both numeric and non-numeric components.

The design features of the information-analytical system for solving tasks were determined. The system of tasks that must be implemented in the information-analytical system was defined, grouping of mathematical models and methods that form the basis of an analytical system unit was performed. The structural-functional diagram of the relevant information-analytical system was developed.

Experimental verification of research results on the example of solving the problem of people grouping according to the labor migration direction has confirmed the efficiency of the developed technology and the possibility of its use to improve the decision making efficiency in the field of HIV/AIDS prevention and treatment in the study of behavioral risks of the target group representatives.

Keywords: labor migrants group structure determination; fuzzy c-means method; information technology.

References

1. Myronyuk, I. S. (2012). Behavioral risk of HIV infection related to labor migration. Preventive Medicine, 2 (18), 7–10.
2. UNAIDS. (2002). Focus: AIDS and mobile populations. Report on the global HIV/AIDS epidemic, 117–123.
3. Bobrik, A. V., Eroshina, K. M., Michel, E. A. (2009). Organization of comprehensive HIV prevention, STD and viral hepatitis among migrant workers. Moscow, 32.
4. Myronyuk, I. S. (2012). Features risk behaviors of HIV-positive migrants Transcarpathian region by region Migration. Scientific Bulletin of the Uzhgorod University, The series "Medicine", 1 (43), 146–151.
5. Mulesa, O. (2013). Consecutive analysis of variations in fuzzy clustering and identification tasks. Bulletin of Kyiv National Taras Shevchenko University, Series of Physical-Mathematical Sciences, 2, 205–209.
6. Mulesa, O. (2013). Technology of quantitative evaluation of high risk groups of infection with human immunodeficiency virus under uncertainty. Proceedings of the National Technical University "KPI", Series: "New solutions in modern technologies", 56 (1029), 172–179.
7. Baturkin, S. A., Baturkina, E. Yu., Zimenko, V. A., Sihinov, Y. V. (2010). Statistical data clustering algorithms in adaptive learning systems. Vestnyk RHRTU, 1 (31), 82–85.
8. Kotov, A., Krasylnykov, N. (2012). Data clustering. Available at: yury.name/internet/02ia-seminar-note.pdf
9. Horbachenko, V. Y. (2013). Networks and Kohonen maps. Available: http://gorbachenko.self-organization.ru/index.html
10. Snytiuk, V. (2005). Evolutionary clustering of complex objects and processes. XI-th International Conference «Knowledge-Dialogue-Solution», Varna, 1, 232–237.
11. Grop, D. (1979). Methods of identification systems. Moscow: Mir, 302.
12. Nakonechny, S., Tereshchenko, T, Romaniuk, T. (2004). Econometrics. Kyiv: KNEU, 520.
13. Mulesa, O. (2015). Adaptation of fuzzy c-means method for determination the structure of social groups. Technology Audit And Production Reserves, 2(2(22)), 73-76. doi: 10.15587/2312-8372.2015.41014
14. Voloshyn, O. F., Mashchenko, S. O. (2010). Decision theory. Kiev: Publishing and Printing Center "Kyivskyi universytet", 366.
15. Orlovskyi, S. A. (1981). Decision making with fuzzy initial information. Moscow: Nauka. Hlavnaia redaktsyia fyzyko-matematycheskoi lyteratury, 208.

PERFORMANCE INCREASE OF IN-MEMORY DATA GRIDS BY USING SOFTWARE TRANSACTIONAL MEMORY (p. 9-14)

Oleksandr Podrubailo

The aim of the paper is to study the possibility of performance increase of in-memory data grids (IMDG) by using software transactional memory. In the present study, the problems of determining the IMDG performance under the refusal of the locking mechanism and use of local and distributed transactional memory were solved. Studies were conducted in the absence of redundancy, and in the triple replication of the data stored. The operational features of the software transactional memory under a constantly loaded in-memory data grid were determined. It is shown that using software transactional memory and reducing the size of transactions allows to achieve performance gains of in-memory data grids of 13–48 %. The proposed method is applicable for grids, combining background data recording in the grid and frequent reading operations (such as data grids for business intelligence, TV Guide data grids, etc.).

Keywords: data grid, in-memory grid, transactional memory, software transactional memory.

References

1. Williams, J. W., Aggour, K. S., Interrante, J., McHugh, J., Pool, E. (2014). Bridging high velocity and high volume industrial big data through distributed in-memory storage & analytics. 2014 IEEE International Conference on Big Data (Big Data), 932–941. doi: 10.1109/bigdata.2014.7004325
2. Pritchett, D. (2008). Base: an acid alternative. Queue, 6 (3), 48–55. doi: 10.1145/1394127.1394128
3. Lomet, D. B. (1977). Process structuring, synchronization, and recovery using atomic actions. Proceedings of the ACM Conference on Language Design for Reliable Software (Raleigh, NC), 128–137.
4. Herlihy, M., Moss, J. E. B. (1993). Transactional memory: Architectural support for lock-free data structures. Proceedings of the 20th Annual International Symposium on Computer Architecture, 289–300. doi: 10.1109/isca.1993.698569

5. Larus, J., Kozyrakis, C. (2008). Transactional memory. Communications of the ACM, 51 (7), 80. doi: 10.1145/1364782.1364800
6. Grossman, D. (2007). The transactional memory / garbage collection analogy. In Proceedings of the ACM Conference on Object-Oriented Programming Systems, Languages, and Applications (Montreal, Canada), 695–706.
7. Shavit, N., Touitou, D. (1995). Software transactional memory . In Proceedings of the 14th ACM Symposium on Principles of Distributed Computing (Ottawa, Canada), 204–213.
8. Herlihy, M., Luchangco, V., Moir, M., Scherer III, W. N. (2003). Software transactional memory for dynamic-sized data structures. In Proceedings of the twenty-second annual symposium on Principles of distributed computing – PODC '03, 92–101. doi: 10.1145/872035.872048
9. Fraser, K., Harris, T. (2007). Concurrent programming without locks. ACM Transactions on Computer Systems, 25 (2), 5–51. doi: 10.1145/1233307.1233309
10. Carvalho, N., Romano, P. (2011). A generic framework for replicated software transactional memories. 2011 IEEE 10th International Symposium on Network Computing and Applications, 271–274. doi: 10.1109/nca.2011.45
11. Saad, M., Ravindran, B. (2011). HyFlow: a high performance distributed software transactional memory framework. Proceedings of the 20th international symposium on High performance distributed computing - HPDC '11, 265–266. doi: 10.1145/1996130.1996167
12. Zhang, H., Chen, G., Ooi, B. C., Tan, K.-L., Zhang, M. (2015). In-Memory Big Data Management and Processing: A Survey. IEEE Transactions on Knowledge and Data Engineering, 27 (7), 1920–1948. doi: 10.1109/tkde.2015.2427795
13. Fernandes, S. (2014). Strongly Consistent Transactions for Enterprise Applications. Using Software Transactional Memory to Improve Consistency and Performance of Read-Dominated Workload. Lisbon, 208.

DEVELOPMENT OF THE GENERALIZED CONFIGURATION MANAGEMENT PROCESS MATHEMATICAL MODEL IN PROJECT MANAGEMENT (p. 14-22)

Sergiy Rudnitskyy

The process of configuration management (CM) in the field of project management (PM) solves the problem of consistency support of the project product and the project itself. The problem is caused by the inevitability of the changes during the project implementation. If the CM processes of specific material objects (project products) are studied deeply enough, the CM processes of the project elements, for example management processes, risks, works, commands, procurement, etc., and, in general, the project itself are investigated only at the conceptual level, and require further work in this direction. In the research, the next step in this direction, namely developing the mathematical, formalized description of the generalized CM process without regard to the object of its application was made. In particular, a formal description of the individual action of the CM process at the abstraction level that allows to present an operation or procedure, or a sub-process in the form of such action was obtained. The classification of actions was introduced, and it was found that the whole CM process can be divided into five groups of actions, each being performed as a response to a specific event. The presence of these groups allows to specify the actions that are executed once, after the object mismatch, periodically and randomly, what is necessary to calculate the performance indices of the process under study. It was also found that the CM process is a set of its embodiments, for which the description scheme was proposed. In addition, the classifi-cation of changes in the controlled object, which may occur during its life cycle was introduced.

Keywords: configuration, configuration management, project, project management, process, optimization, change, formalization.

References

1. Rukovodstvo k Svodu znanii po upravleniiu proektami. (2004). Rukovodstvo PMBOK®. Ed. 3. USA: Project Management Institute, 388.
2. Morozov, V., Rudnitskyy, S. (2013). Conceptual model of the configuration management process in projects. Eastern-European Journal Of Enterprise Technologies, 1(10(61)), 187–193. Available at: http://journals.uran.ua/eejet/article/view/6766
3. Practice Standard for Project Configuration Management. (2007). USA: Project Management Institute, 53.
4. Rudnitskyy, S. (2015). Object configuration management process. Eastern-European Journal of Enterprise Technologies, 2(3(74)), 15–25. doi: 10.15587/1729-4061.2015.39788
5. Rudnitskyy, S. (2015). Development of object model of the generalized configuration management process in project management. Technology Audit And Production Reserves, 2(3(22)), 38–44. doi: 10.15587/2312-8372.2015.41498
6. MIL-HDBK-61A(SE). Military Handbook. Configuration Management Guidance (2001). USA: Department of Defense. Available at: http://acqnotes.com/Attachments/MIL-HDBK-61A%20(SE)Configuration%20Management%20Guidance.pdf
7. EIA-649-B. Configuration Management Standard. (2011). TechAmerica. Available: http://www.techstreet.com/products/1800866
8. Ratushnyi, R. T., Sydorchuk, O. V., Tymochko, V. O. (2005). Naukovo-metodychni pidstavy upravlinnia konfihuratsiieiu proektu udoskonalennia systemy pozhezhohasinnia u silskomu administratyvnomu raioni. Visnyk Lviv. DAU: Ahroinzhenerni doslidzhennia, 9, 38–47.
9. Mykhaliuk, M. A. (2008). Obhruntuvannia metodiv i modelei identyfikatsii ta kontroliu konfihuratsii proektiv system tsentralizovanoi zahotivli moloka. Lviv, 20.
10. Tatomyr, A. V. (2009). Uzghodzhennia konfihuratsii proektiv servisnykh ta obsluhovuvanykh system (stosovno elektrozabezpechennia silskohospodarskykh pidpryiemstv za vykorystannia enerhii vitru). Lviv, 20.
11. Reilly, M. A. (1995). Spent Nuclear Fuel Project Configuration Management Plan. doi: 10.2172/97000
12. Naliutin, N. Yu. (2008). Metody i programmnye sredstva upravleniia konfiguratsiiami proektov razrabotki vstroennyh sistem. Moscow, 226.
13. IEEE Standard for Software Configuration Management Plans. (1998). IEEE Std 828-1998. doi: 10.1109/ieeestd.1998.88281
14. Vann, J. M. (1996). TWRS Configuration management program plan. doi: 10.2172/662064
15. Morozov, V. V., Cherednichenko, A. M., Shpilova, T. I.; In: Morozov, V. V.; Un-t ekonomiky ta prava «KROK». (2009). Formuvannia, upravlinnia ta rozvytok komandy proektu (povedinkovoi kompetentsii). Kiev: Takson, 464.
16. Bushueva, N. S. (2007). Modeli i metody proaktivnogo upravleniia programmami organizatsionnogo razvitiia. Kiev: Nauk. svit, 199.
17. Bushuev, S. D., Yaroshenko, F. A., Tanaka, H. (2012). Upravlenie innovatsionnymi proektami i programmami na osnove sistemy znanii P2M. Kiev: Sammit-Kniga, 272.
18. Bushuev, S. D., Morozov, V. V. (1999). Dinamicheskoe liderstvo v upravlenie proektami. Kiev: VIPOL, 312.
19. In: Bushuev, S. D. (2010). Kreativnye tehnologii upravleniia proektami i programmami. Kiev: Sammit-Kniga, 768.
20. Moreira, M. E. (2010). Adapting Configuration Management for Agile Teams: Balancing Sustainability and Speed. John Wiley & Sons, 302.
21. Fowler, M. (2003). UML Distilled: A Brief Guide to the Standard Object Modeling Language. Ed. 3. Addison-Wesley, 208.
22. Venttsel', E. S. (1972). Issledovanie operatsii. Moscow: Sovetskoe radio, 552.

INDIVIDUALIZATION OF STUDENTS' INDEPENDENT WORK ON THE BASIS OF INFORMATION TECHNOLOGIES (p. 22-30)

Victoria Shevchenko

The study explores an information technology model of forming individual trajectories, which is conducive to organizing and managing students' independent work. The existing methods of teaching at the university level allow improvement of students' performance with the help of principles of autonomous learning that are implemented during individual work. We have suggested the structure of the devised model and considered several methods that involve the proposed technology as well as the general principle of the information technology functioning. A distinctive feature of the information technology is that it incorporates a method of forming and a method of adjusting individual trajectories of students' independent work. These methods are based on performance prediction and aided by the modified method of cluster analysis of the McKean k-means; they take into account individual performance and motivation of each student with the help of production models of guiding the student.

The suggested model of information technology is aimed at solving the problems of individualization in the higher education process and improving the academic performance of students.

Keywords: students' independent work, information technology, individual trajectories, prediction, production-frame models.

References

1. Lamb, R. L., Vallett, D. B., Akmal, T., Baldwin, K. (2014). A computational modeling of student cognitive processes in science education. Computers & Education, 79, 116–125. doi: 10.1016/j.compedu.2014.07.014
2. Stoyanova, L. Y. (2010). The Learning Process Management in E-learning Environment in the Technology School "Electronic Systems" Associated with the Technical University of Sofia. Technological Developments in Education and Automation, 271–274. doi: 10.1007/978-90-481-3656-8_50
3. Osetrin, K. E., Pianykh, E. G. (2011). Information Technology in the organization of independent work of students. Vestnik TSPU, 13, 210–213.
4. Fazlollahtabar, H., Mahdavi, I. (2009). User/tutor optimal learning path in e-learning using comprehensive neuro-fuzzy approach. Educational Research Review, 4 (2), 142–155. doi: 10.1016/j.edurev.2009.02.001
5. Dias, S. B., Diniz, J. A. (2013). FuzzyQoI model: A fuzzy logic-based modelling of users' quality of interaction with a learning management system under blended learning. Computers & Education, 69, 38–59. doi: 10.1016/j.compedu.2013.06.016
6. Lupo, T. (2013). A fuzzy ServQual based method for reliable measurements of education quality in Italian higher education area. Expert Systems with Applications, 40 (17), 7096–7110. doi: 10.1016/j.eswa.2013.06.045
7. Chen, S.-M., Li, T.-S. (2013). Evaluating students' answerscripts based on interval-valued intuitionistic fuzzy sets. Information Sciences, 235, 308–322. doi: 10.1016/j.ins.2012.12.031
8. Kwok, R. C. W., Ma, J., Vogel, D., Zhou, D. (2001). Collaborative assessment in education: an application of a fuzzy GSS. Information & Management, 39 (3), 243–253. doi: 10.1016/s0378-7206(01)00093-3
9. Problems integrating national institutions of higher education in the European educational environment: Proceedings of the international scientific and technical conference. Vol. 2 (2012). Kharkov: Fort, 136.
10. Shevchenko, V. A. (2013). Testing the effectiveness of student learning using methods of nonparametric statistics. Vestnik KhNAHU, 60, 18–21.
11. Meteshkin, K. A., Shevchenko, V. A. (2012). Vague understanding of students clusterization results. Public information and computer integrated technologies, 56, 162–168.
12. Shevchenko, V. A. (2015). Information technology of forming individual trajectories of independent students work. Vestnik NTU «KhPI», 21 (1130), 76–83.

A LINGUISTIC MODEL FOR ASSESSING INFORMATION SYSTEM RISKS (p. 30-35)

Vladimir Shaporin, Petr Tishin, Ruslan Shaporin, Nikolai Kopytchuk

Modern trends in the development of information systems require more appropriate ways of providing information security. The most important step in devising complex information protection is to analyze the risks in the target information system.

The study has revealed that the existing methods have several disadvantages such as absence of facts testifying to uncertain security threats and probabilistic approaches that do not account for the complexity of processes occurring in the system.

Given the difficulties and shortcomings, the authors have suggested that risks should be analyzed through the theory of fuzzy sets and linguistic variables. The approach includes development of fuzzy models allowing to assess risks as probable or emerging and to evaluate whether the information system assets are satisfactory.

The suggested approach can help analyze the risks of an information system, using natural language that is understood by any owner of the assets; it adds experience in security design.

Keywords: Coras methodology, asset, risk, fuzzy knowledge bases, linguistic variables.

References

1. Mironova, V. G. (2012). Seti Petri–Markova kak instrument sozdaniya analiticheskikh modelei dlya osnovnykh vidov nesanktsionirovannogo dostupa v informatsionnoi sisteme. Doklady TUSURa, 2 (1 (25)), 20–24.
2. Lund, M. S., Solhaug, B., Stolen, K. (2011). Model-Driven Risk Analysis. Springer-Verlag. Berlin, 55–62. doi: 10.1007/978-3-642-12323-8
3. Yaqub, S. C. (2007). Relating CORAS diagrams and Markov chains. Master thesis. University of Oslo.
4. Zadeh, L. A. (1997). Toward a theory of fuzzy information granulation and its centrality in human reasoning and fuzzy logic. Fuzzy Sets and Systems, 90 (2), 111–127. doi: 10.1016/s0165-0114(97)00077-8
5. Azhmukhamedov, I. M. (2009). Modelirovanie na osnove ekspertnykh suzhdenii protsessa otsenki informatsionnoi bezopasnosti. AGTU bulletin. Upravlenie, vychislitel'naya tekhnika i informatika, 2, 101–109.
6. Nieto-Morote, A., Ruz-Vila, F. (2011). A fuzzy approach to construction project risk assessment. International Journal of Project Management, 29 (2), 220–231. doi: 10.1016/j.ijproman.2010.02.002
7. Shaporin, V. O., Tishin, P. M., Kopytchuk, N. B., Shaporin, R. O. (2014). Razrabotka nechetkikh lingvisticheskikh modelei atak dlya analiza riskov v raspredelennykh informatsionnykh sistemakh. Sovremennye informatsionnye i elektronnye tekhnologii: 15-ya mezhdunarodnaya nauchno-prakticheskaya konferentsiya, 131–132.
8. Shaporin, V. O., Tishin, P. M., Kopytchuk, N. B., Shaporin, R. O. (2013). Otsenka veroyatnosti provedeniya ataki na setevye resursy s ispol'zovaniem apparata nechetkoi logiki. Elektrotekhnicheskie i komp'yuternye sistemy, 12 (88), 95–101.

9. Nesterenko, S. A., Tishin, P. M., Makovetskii, A. S. (2013). Model' ontologii apriornogo podkhoda prognozirovaniya problemnykh situatsii v slozhnykh vychislitel'nykh sistemakh. Elektrotekhnicheskie i komp'yuternye sistemy, 10 (86), 111–119.

10. Kopytchuk, N. B., Tishin, P. M., Tsyurupa, M. V. (2014). Protsedura sozdaniya nechetkikh modelei analiza riskov v slozhnykh vychislitel'nykh sistemakh. Elektrotekhnicheskie i komp'yuternye sistemy, 13 (89), 215–222.

11. Ryzhov, A. P. (2003). Elementy teorii nechetkikh mnozhestv i ee prilozhenii. Dialog – MGU, 53–65.

12. Shtovba, S. D. (2003). Proektirovanie nechetkikh sistem sredstvami MATLAB. Goryachaya liniya – Telekom, 263–275.

13. Azhmukhamedov, I. M. (2012). Reshenie zadach obespecheniya informatsionnoi bezopasnosti na osnove sistemnogo analiza i nechetkogo kognitivnogo modelirovaniya. Monografiya. Astrakhan', 344.

SPACE PERCEPTION ANALYSIS IN THE PANINI PROJECTION AND ITS USING IN COMPUTER GRAPHICS (p. 36-43)

Petr Kachanov, Andrey Zuev, Konstantin Yatsenko

The main parameter in the study of virtual reality for the human-computer interaction is the information received by the person. However, the transformation from three-dimensional space to two-dimensional is accompanied by a distortion in the resulting images. The paper describes the Panini projection model in terms of the information content and engineering psychology.

The analysis of the data describing the features of human visual perception of the virtual space is performed. It is shown that the mathematical model of the Panini projection is based on geometric transformations, which correspond to the system of human visual perception and produces biologically correct three-dimensional images. A description of non-planar perspective projections is given.

Finally, it is concluded that the simple geometric transformations, which are available to the observer can improve the information content of the synthesized images. The results of using the described projection models in computer graphics were obtained. A comparison of images in the perspective projection and Panini projection was carried out. The reasons of using the described projection type were explained.

Keywords: Panini projection, veduta, space perception, spherical projection, cylindrical projection, space compression.

References

1. Kovaljov, A. M., Lishhenko, V. E., Stepanov, M. V. (2007). O sistemah perspektiv dlja komp'juternoj grafiki. Avtometrija, 43 (3), 48–56.

2. Raushenbah, B. V. (1986). Sistemy perspektivy v izobrazitel'nom iskusstve. Obshhaja teorija perspektivy. Moscow: Nauka, 256.

3. Kovalev, A. M. (2002). Ob uvelichenii predmetov v perceptivnom prostranstve. Avtometrija, 38 (5), 86–94.

4. Fleck, M. (1995). Perspective Projection: the Wrong Imaging Model. University of Iowa, Computer Science. Available at: http://mfleck.cs.illinois.edu/my-papers/stereographic-TR.pdf

5. Bayarri, S. (1995). Computing non-planar perspectives in real time. Computers & Graphics, 19 (3), 431–440. doi: 10.1016/0097-8493(95)00013-3

6. Yonggao, Y., Chen, J. X., Beheshti, M. (2005). Nonlinear perspective projections and magic lenses: 3D view deformation. IEEE Computer Graphics and Applications, 25 (1), 76–84. doi: 10.1109/mcg.2005.29

7. Hershenson, M. (1998). Visual Space Perception: A Primer. MIT Press, 269.

8. Sharpless, T., Postle, B., German, D. (2010). Pannini: A New Projection for Rendering Wide Angle Perspective Images. International Symposium on Computational Aesthetics, London. Available at: http://tksharpless.net/vedutismo/Pannini/panini.pdf

9. Kovalev, A. M. (1998). Virtual'naja real'nost' v sfericheskoj perspektive. "Grafikon-98": trudy 8-j Mezhdunar. konf. po komp'juternoj grafike i vizualizacii, Moscow, 95–102.

10. Kovalev, A. M. (2003). O vizual'no vosprinimaemom prostranstve predmetov Avtometrija, 39 (6), 3–12.

11. Casas, F. R. (1983). Flat-Sphere Perspective. Leonardo, 16 (1), 1–9. doi: 10.2307/1575034

12. Shiffman, H. R. (2003). Oshhushhenie i vosprijatie. Piter, 928.

13. Ikeuchi, K. (1984). Shape from regular patterns. Artificial Intelligence, 22 (1), 49–75. doi: 10.1016/0004-3702(84)90025-0

14. Polack, J. A., Piegl, L. A., Carter, M. L. (1997). Perception of images using cylindrical mapping. The Visual Computer, 13 (4), 155–167. doi: 10.1007/s003710050096

15. Michael, K. (1986). The psychology of perspective and renaissance art. Cambridge University Press.

16. Vishwanath, D., Girshick, A. R., Banks, M. S. (2005). Why pictures look right when viewed from the wrong place. Nature Neuroscience, 8 (10), 1401–1410. doi: 10.1038/nn1553

17. Pirenne, M. (1970). Optics, Painting & Photography. Cambridge University Press.

DEVELOPMENT OF AN ANALYTICAL ESTIMATION METHOD OF THE FAULT RISK IN THE POWER SYSTEM (p. 44-50)

Mykola Kosterev, Volodymyr Litvinov

Modern risk-oriented management of electric power system requires the definition of risk as an integral operation index that allows to reliably characterize the power system state. Assessment of the power system state is performed under a significant number of technical and operational uncertainties.

The approach to the analytical determination of the fault risk in the electric power system without regular probabilistic and statistical modeling using the Monte Carlo method was proposed. The developed risk assessment method lies in determining, based on a one-time probabilistic-statistical modeling, analytical expression, which allows to reliably perform a rapid assessment of the fault risk in the power system based only on the equipment state characteristics and power system prefault parameters.

Based on the developed method, the algorithm of the rapid risk assessment of dynamic instability in the power system was determined. The proposed algorithm allows to obtain an analytical expression for the fault risk in the power system as a polynomial dependence. In this interpretation, the risk is a function of the technical state of the power system elements and prefault conditions. Using the developed algorithm, risk assessment of dynamic instability in the test circuit of the power system was carried out.

Keywords: risk, failure probability, rapid assessment, dynamic stability, power system, power line.

References

1. Ciapessoni, E., Cirio, D., Gagleoti, E. (2008). A probabilistic approach for operational risk assessment of power systems. CIGRE, C4–114.

2. Handschin, E., Jurgens, I., Neumann, C. (2008). Long term optimization for risk-oriented asset management. 16th Power Systems Computation Conference, Glasgow. Avail-

able at: http://www.pscc-central.org/uploads/tx_ethpublications/pscc2008_597.pdf

3. Kosterev, M. V., Bardyk, E. I., Litvinov, V. V. (2013). Risk Estimation of Induction Motor Fault in Power System. WSEAS Transactions on Power Systems, 4 (8), 217–226.

4. Voropaj, N. I., Diachenko, A. V. (2011). Otsenka nadiozhnosti podstantsii veroiatnostnym metodom. Elektricheskie stantsii, 1, 35–41.

5. Litvinov, V. V. (2012). Otsinka ryzyku potuchennia stiikosti dvygunovogo navantazhennia pry vidmovah elektroobladnannia v pidsystemi EES. Kyiv, 20.

6. Qui, Q. (2003). Risk assessment of power catastrophic failures and hidden failure monitoring and control system. Blacksburg, Virginia, 212.

7. Sitnikov, V. F., Skopintsev, V. A. (2007). Veroiatnostno-statisticheskii podhod k otsenke resursov elektrosetevogo oborudovania v protsesse ekspluatatsii. Elektrichestvo, 11, 9–15

8. Litvinov, V. (2014). Investigation of emergency automation failures influence on the power system accident risk. Eastern-European Journal of Enterprise Technologies, 6(8(72)), 47-56. doi: 10.15587/1729-4061.2014.32043

9. Schwan, M., Weck, K.-H., Roth, M. (2004). Assessing the impact of maintenance strategies on supply reliability in asset management methods. CIGRE, C1–108.

10. Sobol, I. M. (1973). Chislennye metody Monte-Karlo. Moscow: Nauka, 312.

11. Kosterev, M. V., Bardyk, E. I., Litvinov, V. V. (2011). Otsinka imovirnosti vidmovy elektroobladnannia pry keruvanni rezhymamy elektrychnoi systemy. Naukovi pratsi Donetskogo natsionalnogo tehnichnogo universytetu, 11 (186), 199-204.

NEURAL-NETWORK APPROACH TO STRUCTURAL TUNING OF CLASSIFICATION RULES BASED ON FUZZY RELATIONAL EQUATIONS (p. 51-57)

Hanna Rakytyanska

An adaptive approach to structural tuning of classification rules based on solving fuzzy relational equations, allowing to avoid the fuzzy knowledge base redundancy is proposed. The approach lies in building and training the neural-fuzzy backward chaining network, the isomorphic system of fuzzy relational equations, which allows to adjust the structure of fuzzy rules as new experimental data appear.

Because of the lack of effective selection methods, there is no single methodological standard for structural tuning of fuzzy rules. Modern neural-fuzzy systems use heuristic selection methods to reduce the number of rules without losing the distinctive ability of the network.

It was found that using the neural-fuzzy backward chaining network allows to avoid the knowledge base redundancy while preserving the inference precision. The number of rules in the class is equal to the number of solutions, and the form of membership functions of fuzzy terms is defined by intervals of values of input variables in each solution. This approach is an alternative to the classical approach, based on selection of rules from a set of rules-candidates that prevents obtaining compact fuzzy knowledge bases.

Keywords: fuzzy relations, neural-fuzzy backward chaining network, solving systems of fuzzy relational equations.

References

1. Yager, R., Filev, D. (1994). Essentials of fuzzy modeling and control. New York: John Willey & Sons, 408.

2. Rotshtein, A. (1999). Intellectual technologies of identification: fuzzy sets, genetic algorithms, neural networks. Vinnitsa: UNIVERSUM-Vinnitsa, 320.

3. Alcalá, R., Alcalá-Fdez, J., Gacto, M., Herrera, F. (2009). Improving fuzzy logic controllers obtained by experts: a case study in HVAC systems. Applied Intelligence, 31 (1), 15–30. doi:10.1007/s10489-007-0107-6

4. Dubois, D., Prade, H. (1996). What are fuzzy rules and how to use them. Fuzzy Sets and Systems, 84 (2), 169–189. doi: 10.1016/0165-0114(96)00066-8

5. Gabrys, B., Bargiela, A. (2000). General fuzzy min-max neural network for clustering and classification. IEEE Transactions on Neural Networks, 11 (3), 769–783. doi: 10.1109/72.846747

6. Wang, L., Fu, X. (2005). A simple rule extraction method using a compact RBF neural network. Advances in Neural Networks, 3496, 682–687. doi: 10.1007/11427391_109

7. Cortes, C., Vapnik, V. (1995). Support-vector networks. Machine Learning, 20 (3), 237–297. doi: 10.1023/A:1022627411411

8. Zhang, D., Duan, A., Fan, Y., Wang, Z. (2008). A new approach to division of attribute space for SVR based classification rule extraction. Advances in Neural Networks, 5263, 691–700. doi: 10.1007/978-3-540-87732-5_77

9. Rakytyanska, H. (2015). Fuzzy classification knowledge base construction based on trend rules and inverse inference. Eastern-European Journal of Enterprise Technologies, 1(3(73)), 25–32. doi: 10.15587/1729-4061.2015.36934

10. Di Nola, A., Sessa, S., Pedrycz, W., Sanchez, E. (1989). Fuzzy relation equations and their applications to knowledge engineering. Dordrecht: Kluwer Academic Press, 278. doi: 10.1007/978-94-017-1650-5

11. Rotshtein, A., Rakytyanska, H. (2012). Fuzzy Evidence in Identification, Forecasting and Diagnosis. Studies in Fuzziness and Soft Computing. Springer Berlin Heidelberg, 314. doi: 10.1007/978-3-642-25786-5

12. Zadeh, L. (1983). A computational approach to fuzzy quantifiers in natural language. Computers and Mathematics with Applications, 9, 149–184. doi: 10.1016/0898-1221(83)90013-5

13. Rotshtein, A., Rakytyanska, H. (2009). Adaptive diagnostic system based on fuzzy relations. Cybernetics and Systems Analysis, 45 (4), 623–637. doi: 10.1007/s10559-009-9130-4

14. Rotshtein, A., Rakytyanska, H.; In: Sarma, R. D. (2011). Fuzzy logic and the least squares method in diagnosis problem solving. Genetic diagnoses. New York: Nova Science Publishers, 53–97.

15. Bojadziev, G., Bojadziev, M. (1997). Fuzzy logic for business, finance and management. New York: World Scientific Publishing, 252. doi: 10.1142/9789812819789_0005

AN UPGRADE OF PREDICTORFUNCTIONS BASED ON THE ANALYSIS OF TIME SERIES FOR MASHING BEER WORT (p. 57-62)

Nick Chernetski, Vasil Kishenko, Anatoly Ladanyuk

The paper presents research findings concerning the complex system of the mashing and brewing section of the brewery by methods of nonlinear dynamics. We have analysed the time series of the variable technological processesof making beer wort. The prior information and analysis on the dimensions of the reconstituted phase trajectories of the object determined our selection of the structures and functions of the basic models of the dynamics in the process of mashing wort; the structures and functions had the form of nonlinear algebraic polynomials and fractional rational functions of the 3–6 order, respectively. As a result, the calculated and established coefficients of the dynamic models have provided adequacy of the experimental data model that is sufficient for practical purposes: the prediction error does not exceed 6 %. Simulation in the VectorODE package made it possible to upgrade predictor functions for predicting the progress of mashing beer wort in chaotic regimes of the process. We have determined the optimal structure and parameters of differential equations as predictors for the criteria of time and prediction accuracy. Besides, we have

proved effectiveness of the obtained models for predicting the behaviour of the object in a wide range, including chaotic regimes. The derived models were checked through time test series that showed the effectiveness of these predictor functions: the depth of the prediction was 8–17 minutes with an accuracy of 3 % to 7 %. Using predictor functions ensures the implementation of effective management strategies in the technological complex of beer production in conditions of intermittency.

Keywords: prediction, mathematical model, predictor function, mashing wort.

References

1. Bezruchko, B., Smirnov, D. (2005). Mathematical modeling and chaotic time series. Saratov: GosUNTs College, 320. doi: 10.5281/zenodo.20131
2. Bezruchko, B., Smirnov, D. (2000). Reconstruction of ordinary differential educations, time series. Saratov: GosUNTs College, 46. doi: 10.5281/zenodo.20132
3. Andreev, K., Krasichkov, L. (2002). Simulation of the electrical activity of a neuron using a piecewise continuous maps. Pis'ma v ZhTF, 29 (13), 46–52. doi:10.5281/zenodo.20133
4. Anischenko, V., Astakhov, V., Vadivasova, T., Neumann, A., Strelkova, G., Szymanski-Guyer, L. (2011). Nonlinear effects in chaotic and stochastic systems. Moscow: Institute of Computer Science, 535. doi: 10.5281/zenodo.20134
5. Grishin, I., Mankiewicz, E., Telegin, K., Sheludko, A. (2008). The solution of problems of parametric identification processes chaotic dynamics. Vesnik YuUrGU, 3, 44–50. doi: 10.5281/zenodo.20135
6. Bezruchko, B., Dikan, T., Smirnov, D. (2001). Global reconstruction of model equations for the implementation of the transition process. Izvestiia vuzov. Prikladnaia nelineinaia dinamika, 9 (3), 3–12. doi: 10.5281/zenodo.20136
7. Bezruchko, B., Levin, Y., Smirnov, D. (2001). Modelling of non-autonomous systems of time series. Saratov: Publ. GosUNTs "College", 44. doi: 10.5281/zenodo.20137
8. Volkov, I., Zuev, S., Tsvetkov, G. (1999). Random processes. Moscow: Publishing House of Moscow State Technical University, 448. doi: 10.5281/zenodo.20138
9. Gnedenko, B. (2005). The course of the theory of probability. Ed. 8. Moscow: Editorial URSS, 448. doi: 10.5281/zenodo.20139
10. Dmitriev, A., Panas, A. (2002). Chaos: New media for communication systems. Moscow: Publishing House of Physical and mathematical literature, 252. doi: 10.5281/zenodo.20140