ABSTRACT AND REFERENCES

INFORMATION TECHNOLOGY. INDUSTRY CONTROL SYSTEMS

THE METHOD OF SOCIO-TECHNICAL SYSTEMS INFORMATIONAL STABILITY EVALUATION AT THE INFORMATIONAL WAR CONDITIONS (p. 4-11)

Andrey Dudatyev,
Vladimir Luzhetsky, Dmitriy Korotaev

The method of evaluation of the informational stability of socio-technical systems, which are influenced by specific informational and psychological operations in the information war is presented. The method uses a logical-probabilistic model and a probabilistic measure for evaluating the informational stability of the system. The proposed informational stability measure is based on the concept of minimum unit of information, designed to change human consciousness – a meme and uses probabilistic estimates of occurrence of so-called destructive and compensatory memes, i. e. the meme, used for the informational and psychological operation (reprogramming of the consciousness of the social part of the SLS) and the compensating meme, the use of which minimizes the consequences of the destructive meme. For decision-making with regard to the stability of the social part of the SLS, a flexible scale that can be adapted to any object of research is proposed.

An approach to the construction of the so-called vector of stability of the social part of the SLS, which provides a visualization of the derived probabilistic estimates of a violation of confidentiality, integrity and availability, is proposed.

The method is of practical interest since it allows considering an actually weakly formalized class of threats – informational and psychological operations, the aim of which is a destructive impact on the social part of the SLS. The proposed method is useful for the decision-making on the management of complex informational security at the "enterprise-region-state" level.

Keywords: information war, informational stability, informational and psychological operation, probabilistic stability measure, information meme.

References

1. Harchenko, V. P. (2009). Kiberterrorizm na aviacionnom transporte: zb. nauk. Problemi informatizacyi ta upravlinnya, 4 (28), 131–140.
2. Vilskij, G. B. (2012). Informacionnye riski sudovozhdeniya. Nauk. Vistnik HDMA, 1 (4), 17–26.
3. Dudikevich, V. B. (2012). Problemi ocinki efektivnosti sistem zahistu. Visnik Nacionalnogo universitetu «Lvivs'ka politexnika». Ser.: Avtomatika, vimiryuvannya ta keruvannya, 741, 118–122.
4. Miroshnik, M. A. (2015). Rozrobka metodiv ocinki efektivnosti zahistu informacyi v rozpodilenih kompyuternih sistemah. Informacijno-keruyuchi sistemi na zaliznichnomu transporti: naukovo-texnichnij zhurnal, 4 (113), 39–43.
5. Lahno, V. A., Grabaryev, A. V. (2016). Improving the transport cyber security under destructive impacts on information and communication systems. Eastern-European Journal of Enterprise Technologies, 1/3 (79), 4–11. doi: 10.15587/1729-4061.2016.60711
6. Artemov, A. A. (2015). Teoretichiskie osnovi informacionnogo upravlenia. Informacionnue voiny, 3, 83–97.
7. Ciganov, V. V. (2015). Globalnoe informacionnoe protivoborstvo. Informacionnue voiny, 2, 7–13
8. Malkov, S. U. (2015). Model ustoichivosti/destabilizacii politicheskih system. Informacionnie voyni, 1, 7–18.
9. Lundberg, J., Rogier, W. (2013). The resilience analysis matrix (RAM): visualizing functional dependencies in complex socio-technical systems. 5th symposium on resilience engineering managing trade-offs.
10. Oosthuizen, R., Pretorius, L. (2013). An analysis methodology for impact of new technology in complex sociotechnical systems. 2013 International Conference on Adaptive Science and Technology. doi: 10.1109/icastech.2013.6707508
11. Simmons, M. P., Adamic L. A., Adar E. (2011). Memes Online: Extracted, Subtracted, Injected, and Recollected. ICWSM, 11, 17–21.
12. IBMSecurity Services (2014). Cyber Security Intelligence Index. Available at: http://media.scmagazine.com/documents/82/ibm_cyber_security_intelligenc_20450.pdf
13. Andreeva, O. M., Musienko, K. (2014). Kiberzbroya ta analiz ii destruktivnoi diyalnosti na prikladi vplivu virusu novogo pokolinnya STUXNET na iransku yadernu programu. Actual problems of international relations, 1 (103).
14. Ostapenko, G. A. (2007). Informacionnie operacii I ataki v sociotehnicheskih sistemah. Moscow: Goryachaya liniya – Telekom, 134
15. Dudatyev, A. V. (2015). Modeli ta organizacia protydii informaciynim atakam. Zahist informacii, 2, 157–162.
16. Chistyakov, V. P. (1987). Kurs teorii veroyatnostey. Moscow: Nauka, 240.

ANALYSIS OF APPLYING METHODS OF DATA COMMUNICATION BETWEEN PROGRAMMATIC UNITS IN ENGINEERING CALCULATIONS (p. 11-18)

Dmytro Sidorov, Irina Kazak

The study considers methods of data communication between programming units for performing engineering calculations of technological equipment through Fortran 90 and more advanced examples of software that are used in mechanical engineering and related industries. Modern Fortran was applied to analyzing methods of data communication between programming units (through lists of parameters, common blocks, modules, and a file interface) that are involved in engineering calculations for technological equipment to expand professional usability of such methods for engineers.

The analysis has revealed a possible loss of data calculation accuracy in case of using a file interface to transfer data between programming units. Other data communication methods guarantee obtaining results within the accuracy of the bit grid for particular data types. Numerous results of testing these programs and the examples in this study show that the calculated data coincide completely in any transfer from one of these methods to another as well as in combining the methods. Among all the considered methods, we have determined that the use of modular

design of the interface between programming units seems to be quite an optimal compromise between convenience of programming and efficiency of operating a particular application, with the guarantee of obtaining quite accurate results. In the field of chemical engineering, professional modern Fortran-based engineering calculations of technological equipment can be more efficient if they are made by using different methods of data communication between programming units.

Keywords: loss of accuracy, programmatic unit, communication of data, Fortran, mechanical engineer, engineering calculations.

References

1. Nemnyugin, M. A., Stesik, O. L. (2004). Modern Fortran. Tutorial. Petersburg, 496.
2. Bartenev, O. V. (2004). Modern Fortran. Petersburg, 390.
3. Ryzhkov, Y. (1999). PowerStation Fortran Programming for Engineers Petersburg, 159.
4. Breach, Z. S., Kapilevich, D. V., Klevtsova, N. A. (1991). Fortran 77 EU PC. Moscow, 285.
5. Ward, T., Bromhead, E. (1993). Fortran programming and art personal computers. Moscow, 352.
6. Andreeva, E. N., Falina, I. N. (2007). Encyclopedia of Computer Science teachers. Issue 5. Magazine Computer, 15. Available at: http://inf.1september.ru/article.php?ID=200701504
7. Akimova, E. N. (2015). Fundamentals of programming in Fortran. Tutorial. Ekaterinburg, 90.
8. Language Reference Manual Fortran 95. Available at: http://www.math.spbu.ru/user/rus/cluster/Doc/Library/fortran95/langref/langr_oglav.shtml
9. Gorelik, A. M. Glossary of Terms Language FORTRAN 95. Available at: http://www.parallel.ru/tech/tech_dev/terms.html
10. Encyclopedia of Mechanical Engineering XXL. Equipment, materials, mechanical and ... . Available at: http://mash-xxl.info/info/106660/
11. Antonov, A. S. (2002). Introduction to parallel computing. Toolkit. Moscow, 69.
12. Badenkov, V. L. (2010). High-performance computing. Tutorial. St. Petersburg, 180.
13. Bea, S. A., Carrera, J., Ayora, C., Batlle, F., Saaltink, M. W. (2009). CHEPROO: A Fortran 90 object-oriented module to solve chemical processes in Earth Science models. Computers & Geosciences, 35 (6), 1098–1112. doi: 10.1016/j.cageo.2008.08.010
14. Berg, B. A., Wu, H. (2012). Fortran code for SU(3) lattice gauge theory with and without MPI checkerboard parallelization. Computer Physics Communications, 183 (10), 2145–2157. doi: 10.1016/j.cpc.2012.03.021
15. Sewell, P., Siamak, N., John, V., Ramin, A., Stephen, A. (2010). Implementing modular adaptation of scientific software Engineering. Applications of Artificial Intelligence, 23 (6), 1000 1011.
16. Rio, G., Laurent, H., Blès, G. (2008). Asynchronous interface between a finite element commercial software ABAQUS and an academic research code HEREZH++. Advances in Engineering Software, 39 (12), 1010–1022. doi: 10.1016/j.advengsoft.2008.01.004
17. Li, X. Q., Chen, Y., Spitler, J. D., Fisher, D. (2009). Applicability of calculation methods for conduction transfer function of building constructions. International Journal of Thermal Sciences, 48 (7), 1441–1451. doi: 10.1016/j.ijthermalsci.2008.11.006
18. Afazov, S. M., Becker, A. A., Hyde, T. H. (2012). Development of a Finite Element Data Exchange System for chain simulation of manufacturing processes. Advances in Engineering Software, 47 (1), 104–113. doi: 10.1016/j.advengsoft.2011.12.011
19. Afazov, S. M., Becker, A. A., Hyde, T. H. (2012). Development of a Finite Element Data Exchange System for chain simulation of manufacturing processes. Advances in Engineering Software, 47 (1), 104–113. doi: 10.1016/j.advengsoft.2011.12.011

INTEGRATION OF ASPECT-ORIENTED APPROACH MEANS IN OBJECT-ORIENTED PROGRAMMING LANGUAGE (p. 19-28)

Valentina Medvedeva, Bohdan Hukivskyi

The problem of complexity of developing and supporting the software cross-cutting concern and its solution using the aspect-oriented approach is examined. The complexity of aspect-oriented programming application in object-oriented programming languages is described. The problem of dependency of the declaration syntax of aspects and the method of their integration is investigated. The architecture that will provide the independence of the syntax of declaration and introduction of aspects in object-oriented programs is proposed. For separation, an urban design pattern that unites declaration of the aspect and its integration method is used. The system displays the classical entities of AOP in the object structure, which facilitates syntax mastering. Three methods for declaring aspects are developed, namely declaration using inheritance from a base class, template class generalization and flexible aspect creation at run time. For integration at compile time, a special integration module and the Roslyn compiler modification, which ensures implementation of the aspect configuration system and introduces advice invocation points in a code are developed. For integration at run time without using the dependency injection container, helper methods for creating proxy classes are designed. Also, modules for popular dependency injection containers, which allow integration by means of these containers are developed. Testing of the developed system, which showed a significant reduction in the size of a source code is carried out. The most pronounced reduction was in large enterprise-level systems. When using introduction at compile time, performance drop of programs is not observed. When using integration at run time, performance losses do not exceed those when using a similar proxy class.

Keywords: aspect-oriented programming, AOP, aspect integration, cross-cutting concern, software architecture, aspect, advice, join point, pointcut.

References

1. Floyd, R. W. (1979). The paradigms of programming. Commun. ACM, 22 (8), 455–460. doi: 10.1145/359138.359140
2. Badd, T. (1997). An Introduction to Object-Oriented Programming. SPb.: «Pyter», 464.
3. Hamma, E., Khelm, R., Dzhonson, R., Vlissides, D. (2014). Design Patterns: Elements of Reusable Object-Oriented Software. SPb.: Pyter, 372.
4. Miles, R. (2012). AspectJ Cookbook. O'Reilly Media, 356.

5. Neyhel, K., Yv'en, B., Hlynn, D., Uotson, K., Skynner M. (2013). S# 4.0 y platforma .NET 4 dlya professyonalov. Moscow: OOO "Y.D. Vyl'yamc", 1543.
6. Gael, F. (2015). PostSharp Roadmap and Support Policies Published. PostSharp Blog. Available at: http://www.postsharp.net/blog/post/PostSharp-Roadmap-and-Support-Policies-Published
7. Yang, H. (2012). Software Reuse in the Emerging Cloud Computing Era. Information Science Reference, 54. doi: 10.4018/978-1-4666-0897-9
8. Sells, C. (2011). Essential.NET: The common language runtime. Addison-Wesley Professional.
9. Gael, F. (2013). Dino Esposito, Cutting Edge – Aspect-Oriented Programming, Interception and Unity 2.0. MSDN Magazine. Available at: https://msdn.microsoft.com/en-us/magazine/gg490353.aspx
10. Rossi, J. (2015). Introduction to AOP With Castle. Castle Project Blog. Available at: http://docs.castleproject.org/Default.aspx?Page=Introduction-to-AOP-With-Castle&NS=Windsor&AspxAutoDetectCookieSupport=1
11. Win, B., Vanhaute, B. (2002). De DeckerSecurity through aspect-oriented programming. In Advances in Network and Distributed Systems Security, 125–138. doi: 10.1007/0-306-46958-8_9
12. Kiczales, G., Lamping, J., Mendhekar, A., Maeda, C., Lopes, C. J., Loingtier, M., Irwin, J. (1997). Aspect-oriented programming. ECOOP'97. Proceedings of the 11th European Conference on Object-Oriented Programming, 220–242. doi: 10.1007/BFb0053381
13. Fowler, M. (2012). Patterns of Enterprise Application Architectur. Addison Wesley.

INFORMATION TECHNOLOGIES OF OPTIMIZING DESIGNS AND MANUFACTURING TECHNIQUES OF RUBBER-METAL PRODUCTS (p. 28-35)

Oksana Saveleva, Iraida Stanovska, Elena Lebedeva, Alla Toropenko

It is shown that a high percentage of defective rubber-metal articles at the manufacturing process output is caused by neglecting the subsystem parameters connectivity at the design stage separately within the design and technology, as well as between these subsystems.

The research is aimed at increasing the rubber-metal articles production stability and improving the rubber products quality through the development and introduction of a new integrated approach to the design and technology parameters optimization.

In the general system of the integrated design of rubber-metal shock-absorbers, the subsystems of designs and manufacturing technologies are singled out, and the correlations between the parameters within these subsystems and the parameters of different subsystems are identified.

Optimization problems have different objective functions, in which arguments often coincide fully or within certain boundaries. This significantly complicates calculations since the optimization problem in this case is often multiobjective and multiextremal. To solve this problem, the method that involves complex evolutionary optimization by means of a genetic algorithm is applied.

For this, new attributes of the genetic algorithm are created. In particular, new star-shaped character models (chromosomes), with internal links between individual parents and flexible constraints on the variation of the latter during optimization are developed. The result is a paradoxical conclusion: there is an additional possibility to perform multi-criteria optimization of the design and manufacturing technology of rubber-metal articles deeper than with Pareto optimization because Pareto optimization involves a single value for all iterations of search of objective functions in the evolutionary optimization, and the arguments on each iteration may differ on some, connection depth-dependant value when using the proposed method.

Keywords: rubber-metal articles, parameters connectivity, genetic algorithms, complex character models.

References

1. Grinberg, P. B., Poleschenko, K. N., Surikov, V. I., Tarasov, E. E. (2012). Tehnologiya naneseniya nanostrukturirovannyih metallopokryitii. Vestnik Omskogo universiteta, 2 (64), 249–252.
2. Eggbeer, D., Bibb, R. J., Evans, L. P., Ji, L. (2013). Evaluation of direct and indirect additive manufacture of maxillofacial prostheses. Institution of Mechanical Engineers, 226 (9), 718–726.
3. Asano, E., Sugira, T., Kimura, N., Toyama, T., Taguchi, T. (2014). Small and lightweight anti-vibration rubber products. Technical Review, 79, 47–50.
4. Rubber metal buffers. Available at: http://www.hokonverschlusstechnik.de/userfiles/pdf/M-%20Gummipuffer/M-1-Rubber-metal-buffers.pdf
5. Banića, M., Stamenković, D., Milošević, M., Miltenović, A. (2013). Tribology Aspect of Rubber Shock Absorbers Development. Tribology in Industry, 35 (3), 225–231.
6. Pinjarla, P., Lakshmana, T. (2012). Design and analysis of a shock absorber. International Journal of Research in Engineering and Technology, 1 (4), 578–592. doi: 10.15623/ijret.2012.0104009
7. Shvets, P. S., Lebedeva, O. Yu., Bondarenko, V. V. (2015). The computer-aided design of rubber-metal products. Pratsi Odeskogo natsionalnogo politehnichnogo universitetu, 63–72.
8. Liu, B., Guo, X., Qi, G., Zhang, D. (2015). Quality evaluation of rubber-to-metal bonded structures based on shearography. Science China Physics, Mechanics & Astronomy, 58 (7), 1–8. doi: 10.1007/s11433-015-5658-7
9. Fan, X. H., Hu, S. Q., Zhang, Z. X. (2009). Random vibration test simulation for a specimen with vibration-isolating rubber considering stiffness nonlinearity. Vibr Shock, 28, 174–176.
10. Yu, L., Xu, J.-M., Han, Q.-L. (2004). Optimal guaranteed cost control of singular systems with delayed state and parameter uncertainties. Proceedings of the 2004 American Control Conference. Central Queensland University Institutional Repository, 4811–4816.
11. Vasilev, E. M. (2012). Robastnaya stabilizatsiya mnogomernyih ob'ektov v sistemah s peremennoy strukturoy. Vestnik Voronezhskogo gosudarstvennogo tehnicheskogo universiteta, 11, 8.
12. Saveleva, O. S., Androsyuk, A. V., Lebedeva, E. Yu. (2011). Model reologii geterogennyih potokov Visoki tehnologiyi v mashinobuduvanni, 1(21), 209–213.
13. Prokopovich, I. V., Shvets, P. S., Lebedeva, E. Yu. (2013). Adaptivnyiy geneticheskiy algoritm dlya «myagkih» evolyutsionnyih vichisleniy. Materiali mizhnarodnoyi

konferentsiyi z avtomatichnogo upravleniya «AVTOMATIKA/AUTOMATICS – 2013», Mikolayiv, 143–144.
14. Lebedeva, E. Yu., Koshulyan, S. V., Abu Shena, Usama. (2014). Metod kontrolya kachestva rezino-metallicheskih amortizatorov. Modelirovanie v prikladnyih nauchnyih issledovaniyah, 60–62.

DEVELOPMENT OF INFORMATION TECHNOLOGY FOR OPERATIONAL CONTROL OF AGRICULTURAL PRODUCTION (p. 36-44)

Aleksandr Grinchak, Olena Davletkhanova, Yaroslav Mykolaichuk

The study suggests a method of improving operational control at an agricultural enterprise in terms of informational support. The method involves dynamic and interactive information analysis panels (dashboards) as an instrument of information analysis support in choosing an optimal real-time solution by the work performer. The suggested approach was developed into a definite improvement pattern for production management at enterprises through introduction of modern information technologies; today it can be already implemented at existing farms. The study provides dashboards for selecting a machine-tractor unit by performance indicators and for building "A flowchart for performing a technological operation," both implemented in the medium of a Microsoft Excel spreadsheet.

The suggested interactive dynamic dashboards in the operational management of agricultural production facilitate rapid re-planning of technological operations by the work performer in real time, significantly reducing the time spent on the necessary calculations and improving their quality. It furthermore produces beneficial effects on the efficiency of production process control at enterprises. The results of evaluating the economic benefits of using the suggested dashboard technology in the operational management of agricultural production indicate an expediency of its implementation by an agricultural enterprise at the operational control level.

Keywords: operational control, information technology, dashboard, Microsoft Excel, plant growing, selection of a machine-tractor unit, flowchart, economic benefit.

References

1. Alexander, M., Walkenbach, J. (2013). Excel Dashboards and Reports. Hoboken: Wiley Publishing Inc., 434.
2. AuCoin, M. (2012). Microsoft Dynamics CRM 2011: Dashboards Cookbook. Birmingham: Packt Publishing Ltd., 248.
3. Polino, M. (2013). Building Dashboards with Microsoft Dynamics GP 2013 and Excel 2013. Birmingham: Packt Publishing, 268.
4. Zhang, L., Stoffel, A., Behrisch, M., Mittelstadt, S., Schreck, T., Pompl, R. et. al. (2012). Visual analytics for the big data era – A comparative review of state-of-the-art commercial systems. 2012 IEEE Conference on Visual Analytics Science and Technology (VAST), 173–182. doi: 10.1109/vast.2012.6400554
5. Nourry, M. (2008). Measuring sustainable development: Some empirical evidence for France from eight alternative indicators. Ecological Economics, 67, 441–456.
6. Tutunea, M., Rus, R. (2012) Business Intelligence Solutions for SME's. Procedia Economics and Finance, 3, 865–870. doi: 10.1016/s2212-5671(12)00242-0
7. Flood, M., Lemieux, V., Varga, M., Wong, W. (2016). The Application of Visual Analytics to Financial Stability Monitoring. Journal of Financial Stability, 50. doi: 10.2139/ssrn.2438194
8. Sarli, P. (2016). Macroprudential oversight, risk communication and visualization. Journal of Financial Stability, 40. doi: 10.1016/j.jfs.2015.12.005
9. Tolonen, A., Shahmarichatghieh, M., Harkonen, J., Haapasalo, H. (2015). Product portfolio management – Targets and key performance indicators for product portfolio renewal over life cycle. International Journal of Production Economics, 170, 468–477. doi: 10.1016/j.ijpe.2015.05.034
10. Davletkhanova, O. Kh., Mykolaichuk, Ya. L. (2014). Cost-effectiveness analysis of the farm management system. Naukovyi ohliad, 10 (9), 5–12.
11. Grinchak, O. V., Mykolaichuk, Ya. L. (2012). Teoretyko-metodolohichni aspekty informatsiinoho zabezpechennia operatyvnoho upravlinnia silskohospodarskym vyrobnytstvom. Ekonomichnyi analiz, 11 (4), 223–227.
12. Butler, M., Herlihy, P., Keenan, P. B. (2005). Integrating information technology and operational research in the management of milk collection. Journal of Food Engineering, 70 (3), 341–349. doi: 10.1016/j.jfoodeng.2004.02.046
13. Zubko, V. M. (2013). The technology and techno-ekonomik evaluation of machine aggregate in the performance communiti monitor soil. Visnyk KhNTUSH, 135, 32–39.
14. Ilchenko, V. Yu., Kobets, A. S., Melnyk, V. P., Karasov, P. I., Kukharenko, P. M., Ilchenko, A. V. (2002). Praktykum z vykorystannia mashyn u roslynnytstvi DDAU, 212.
15. 10. Saaty, T. L. (2008). Decision making with the analytic hierarchy process. Int. J. Services Sciences, 1, 83–89.

AUTOMATION OF CONTROL PROCESSES OF TECHNOLOGICAL EQUIPMENT WITH ROTARY HYDRAULIC DRIVE (p. 44-50)

Volodymyr Sokolov, Yuliya Rasskazova

The problems of automation of control processes of technological equipment with the rotary hydraulic drive are considered. The purpose of the paper is synthesis and study of the ACS for equipment that allows for the stochastic disturbance and observation noise.

The mathematical model of technological equipment with the rotary hydraulic drive as an object of automated control is developed. The mathematical description is a set of linear dynamic links with characteristic parameters, namely the time constant of the pump displacement control process; the time constant of the drive power section; transmission coefficient for the tilt angle of the washer (cylinder block) by the control voltage; transmission coefficient of the drive power section; transmission coefficient for the angular velocity by the loading point.

The ACS of equipment that allows for the observation noise and stochastic disturbance of the control object is synthesized. The solution of the problem of the stochastic optimum linear system with incomplete information about the state according to the method of distribution is divided into two: the problem of synthesis of the optimum supervisor and the deterministic problem of synthesis of the optimum system. To develop the optimum linear controller, the dynamic programming method is used.

The study of dynamic characteristics of the ACS is carried out. It is shown that in the range of possible disturbance

options, the Kalman-Bucy supervisor performs the function of optimum filtering, reduces the transient duration and provides necessary equipment control quality. The calculations of transients for angular displacement and angular velocity at different values of the transmission coefficient of the pump displacement control unit and the transmission coefficient of the controller are made. Recommendations for selecting the optimum values of transmission coefficients allowing for the features of the technological purpose of equipment are given.

The research results can be used to improve the technological equipment, particularly to expand functionality and enhance dynamic characteristics.

Keywords: technological equipment, hydraulic drive, transfer function, stochastic disturbance, automated control system.

References

1. Navrotskyi, K. L. (1991). Teoryia y proektyrovanye hydro- y pnevmopryvodov. Moscow: Mashynostroenye, 384.
2. Sveshnykov, V. K., Usov, A. A. (1988). Stanochnye hydropryvody. Moscow: Mashynostroenye, 512.
3. Sokolova, Ya., Krol, O., Rasskazova, Yu., Sokolov, V. (2015). Mathematical modeling automatic electrohydraulic drive of machine building equipment. TEKA Commission of Motorization and Energetic in Agriculture, 2, 9–14.
4. Novoselov, Yu. K., Bratan, S. M. (2007). Stokhastycheskaia dyahnostyka vzaymodeistvyia ynstrumenta y zahotovky pry kruhlom naruzhnom shlyfovanyy. Suchasni tekhnolohii u mashynobuduvanni. Kharkiv: NTU «KhPI», 91–102.
5. Sokolova, Ya. V., Azarenko, N. H., Hreshnoi, D. S. (2014). Sovershenstvovanye elektrohydravlycheskykh pryvodov mashynostroytelnoho oborudovanyia. VNU im. V. Dalia, 100.
6. Popov, D. N. (1987). Dynamyka y rehulyrovanye hydro- y pnevmosystem. Moscow: Mashynostroenye, 464.
7. Sokolova, Ya. V., Rasskazova, Yu. B. (2015). Modelyrovanye dynamycheskykh kharakterystyk avtomaty-cheskoho hydropryvoda mashynostroytelnoho oborudovanyia. VNU im. V. Dalia, 5 (222), 105–110.
8. Guan, C., Pan, S. (2008). Adaptive sliding mode control of electro-hydraulic system with nonlinear unknown parameters. Control Engineering Practice, 16 (11), 1275–1284. doi: 10.1016/j.conengprac.2008.02.002
9. Rasskazova, Yu. B. (2015). Eksperymentalnie yssledovanyia effektyvnosty re-hulyrovanyia obъemnoho hydropryvoda. VNU im. V. Dalia, 5 (222), 88–91.
10. Kym, D. P. (2004). Teoryia avtomatycheskoho upravlenyia. T. 2. Mnohomernye, ne-lyneinye, optymalnye y adaptyvnye systemy: uchebnoe posobye. Moscow: Fyzmatlyt, 464.

DEVELOPMENT OF A MATHEMATICAL APPARATUS FOR DETERMINING OPERATOR IMAGES OF THE DESIRED QUANTIZED TRANSITION FUNCTIONS OF FINITE DURATION (p. 51-58)

Oleksiy Sheremet, Oleksandr Sadovoy

An important part of modern methods of synthesizing automatic control systems is selection of a characteristic polynomial that can provide the desired dynamics. However, standard polynomials allow only rough setting of the desired dynamic properties of a system.

A more convenient and clear alternative of imparting desired properties to the system in static and dynamic modes is to use not the standard characteristic polynomials but the desired transfer function that is not selected from a list of standard forms but is set solely on the basis of technological requirements and technical implementation capacity of a particular type of equipment.

The study suggests presenting the desired transition function of the automatic control system in a quantized form, i. e. as a set of operated coordinate values that change during a certain period that is relatively small in comparison with the duration of the transition process itself.

A possibility of using quantized transition functions is represented as the sum of time-shifted Heaviside functions for the synthesis of regulators in open-loop control systems. A method has been developed to determine analytically the operator images of the desired quantized transition functions of finite duration by relying only on the values of the signal levels in the quantization time and the value of the quantization period.

Keywords: quantized transition function, the Heaviside function, transition function of finite duration.

References

1. Bianchi, G., Sorrentino, R. (2007). Electronic filter simulation and design. McGraw-Hill Professional, 606.
2. Kuzovkov, N. T. (1976). Modalnoe upravlenie i nablyudayuschie ustroystva. Moscow: Mashinostroenie, 184.
3. Burchnall, J. L. (1951). The Bessel polynomials. Canadian Journal of Mathematics, 3, 62–68. doi: 10.4153/cjm-1951-009-3
4. Graham, D., Lathrop, R. C. (1953). The synthesis of optimum transient response: criteria and standard forms. AIEE Transactions, 72 (II), 1365–1391.
5. Tolochko, O. I. (2004). Analiz ta sintez elektromehanichnih sistem zi sposterigachami stanu: navchalniy posibnik dlya studentiv vischih navchalnih zakladiv. Donetsk: Nord-Pres, 298.
6. Horla, D. (2011). Pole-placement controller with full adaptation for plant with unknown structure in application to servo control. 2011 International Conference on Communications, Computing and Control Applications (CCCA), 1–4. doi: 10.1109/ccca.2011.6031468
7. Wu, F., Wang, L., Rong, W., Sun, L. (2012). Dynamic dimensional synthesis of a precision 6-DOF parallel manipulator. 2012 IEEE International Conference on Mechatronics and Automation, 831–836. doi: 10.1109/icma.2012.6283250
8. Maruschak, Ya. Yu., Kushnir, A. P. (2000). Sintez astatichnoyi pozitsiynoyi SPR metodom uzagalnenogo harakteristichnogo polynoma. Resp. mizhvidomchiy nauk.-tehn. zb. Elektromashinobuduvannya ta elektroobladnannya, 55, 3–10.
9. Maruschak, Ya. Yu. (2000). Metod uzagalnenogo harakteristichnogo polinoma dlya sintezu sistem avtomatichnogo regulyuvannya. Pratsi Mizhnar. konf. z avtomatichnogo keruvannya. Avtomatika 2000, 4, 32–37.
10. Sadovoy, O. V., Sheremet, O. I. (2009). Sintez sistem avtomatichnogo keruvannya zi zminnim harakteristichnim polinomom.Visnik Kremenchutskogo derzhavnogo politehnichnogo universitetu imeni Mihayla Ostrogradskogo, 4/2009 (57), Part 1, 32–35.

11. Madani-Esfahani, S. M., Zak, S. H. (1987). Variable structure control of dynamical systems with bounded controllers. American Control Conference, 90–95.
12. Ikbal, M. M., Abdelfatah M. (2001). Variable structure control of a magnetic levitation system. American Control Conference, 3725–3730.
13. Bartolini, G., Ferrara, A., Usani, E. (1998). Chattering avoidance by second-order sliding mode control. IEEE Transactions on Automatic Control, 43 (2), 241–246. doi: 10.1109/9.661074
14. Sadovoy, O. V., Sheremet, O. I. (2010). Analitichniy sintez regulyatoriv za kvantovanoyu formoyu bazhanoyi perehydnoyi funktsiyi. Zbirnik naukovih prats Dniprodzerzhinskogo derzhavnogo tehnichnogo universitetu: (tehnichni nauki), 1(14), 258–264.
15. Stroustrup, B. (2013). The C++ programming language. Fourth edition. Addison-Wesley, 1347.
16. Computer Engineering Curricula 2016 (2016). Available at: https://www.computer.org/cms/Computer.org/professional-education/curricula/ComputerEngineeringCurricula2016.pdf
17. Isermann, R., Münchhof, M. (2011). Identification of dynamic systems. Springer-Verlag Berlin Heidelberg, 705. doi: 10.1007/978-3-540-78879-9
18. Sheremet, O. I. (2009). Vikoristannya rozkladannya Hevisayda dlya sintezu regulyatoriv sistem avtomatichnogo keruvannya. Visnik Donbaskoyi derzhavnoyi mashinobudyvnoyi akademiyi: Zbirnik naukovih prats, 1 (4E), 189–193.
19. Sheremet, O. I., Sadovoy, O. V., Sohina, Yu. V. (2014). Ponyattya diskretnogo chasovogo ekvalayzera. Zbirnik naukovih prats Donbaskogo derzhavnogo tehnichnogo universitetu, 1, 147–151.