

# Structure and Methods of Control of Oscillating Objects

Vadim Zhmud, Vladimir Semibalamut, Lubomir Dimitrov

*Abstract:* The relevantness of the task of control of oscillatory object is beyond doubt. Yet it is still has not been solved successfully, except for individual examples. In particular, the task of control of the object, having in its transfer function numerator or denominator negative coefficients of the polynomial, is of great interest. This task is even more complicated if there is a negative coefficient both in the numerator and in the denominator. This task can be solved by various methods. It is worth of noting among them the use of the bypass channel, the use of the equalizer, the use of a switching regulator, the use of additional external control loop and the use of the filter on the reference input. The paper dealt with these methods. It demonstrates their advantages and disadvantages with mathematical modeling (simulation). It is shown that the choice of integration method for modeling of integrators and derivative devices can significantly affect to the result of simulation and optimization. This should be considered when choosing the algorithm of the digital controller, because without the choice of integrating method in the control algorithm it is not complete and it can not act. If the calculation would be done without taking into account the this choose, then the results of its use will not match, at least due to the mismatch of the methods for calculating of the integrals and derivatives of the used and signals. It is shown that it is not possible to choose the best method of integration for all problems, because the two most appropriate methods, namely, a simple Euler method and adaptive method Bulirsh-Stoyer, each has both advantages and disadvantages, which are discussed in the paper.

*Key words:* Control, locked loops, regulators, design of controlling systems digital control, feedback, optimization

## REFERENCES

- [1] V.A. Zhmud. "Simulation, research and optimization of locked system of automatic control". Monograph. Novosibirsk. Publishing house of NSTU. 2012. – 335 p.
- [2] A.A. Voevoda, V.A. Zhmud, R.Yu. Ishimtsev, V.M. Semibalamut. "The modeling tests of the new PID-regulators structures". Proceedings of the IASTED International Conference on Applied Simulation and Modelling, ASM 2009. P. 165–168.
- [3] V.A. Zhmud, O. D. Yadrishnikov, A.V. Poloshchuk, A.N.Zavorin. "Modern key technologies in automatics: Structures and numerical optimization of regulators". 2012. Proceedings of 7-th International Forum on Strategic Technology, IFOST-2012.
- [4] V.A. Zhmud, A.V. Liapidevskiy, E.V. Prokhorenko. "The design of the feedback systems by means of the modeling and optimization in the program VisSim 5.0/6". 2010. Proceedings of the IASTED International Conference on Modelling, Identification and Control. P. 27–32.
- [5] V.A. Zhmud, O.D. Yadrishnikov. "Numerical optimization of PID-regulators using the improper moving detector in cost function". Proceedings of the 8-th International Forum on Strategic Technology 2013 (IFOST-2013), vol. II, 28 June – 1 July. Mongolian University of Science and Technology, Ulaanbaator, Mongolia. IEEE organized. 2013. P. 265 – 270. <http://www.must.edu.mn/IFOST2013/>
- [6] V.A. Zhmud, A.V. Poloshchuk, A.A. Voevoda, R.V. Rao. "The Tuning of the PID-Regulator for Automatic Control System of Thermo Energetic Equipment". Proceedings of the Fifth International Conference on Advances in Mechanical Engineering (ICAME-2011), June 06-08, 2011. Surat – 395 007, Gujarat, India. pp. 254-263.
- [7] V.A. Zhmud, A.N. Zavorin. "The method of designing energy-saving controllers for complex objects with partially unknown model". In the book: Issues of control and modeling in complex systems. Proceedings of the XVI International Conference June 30 - July 3, 2014, Samara. Russia. P. 557-567.
- [8] V.A. Zhmud, A.N. Zavorin. "Metodi di ottimizzazione del controllo numerico su una modelli troncati". Italian Science Review, 2014, № 4(13). PP. 686-689. Available at URL: <http://www.ias-journal.org/archive/2014/april/Zhmud.pdf> and <http://www.ias-journal.org/archives/april-2014>
- [9] V.A. Zhmud, L.V. Dimitrov. "The providing of the power saving control of one output value with two controlling channels having different effectiveness and cost of the controlling resource". Proceedings of 23-nd International Scientific and Technical Conference of Transport, Road-Buildong, Agricultural, Hosting & Hauling Military Technics and Technologies "Trans & MOTAUTO '15". 24-27 June, 2015. Varna, Bulgaria. Vol.3. P. 118 – 122. ISSN:1310 – 3946. Publisher: Scientific-technical union of mechanical engineering.
- [10] V.A. Zhmud, L.V. Dimitrov. "The providing of the power saving control of one output value with two controlling channels having different effectiveness and cost of the controlling resource". International Journal for Science, Technics and Innovations for Industry. 2015. Issue 9. ISSN 1313 – 0226. Sofia. Bulgaria. P. 50 – 54. Publisher: Scientific-technical union of mechanical engineering. URL: [www.mech-ing.com/journal](http://www.mech-ing.com/journal)
- [11] V.A. Zhmud, L.V. Dimitrov, O.D. Zavorin. "Calculation of regulators for the problems of mechatronics by means of numerical optimization method". 2014. 12-th International Conference on Actual Problems of Electronic Instruments Engineering (APEIE) 34006. Proceedings. Novosibirsk. 2014. Vol.1. P. 739 – 744.
- [12] V.A. Zhmud, V.M. Semibalamut, A.S. Vostrikov. "Feedback Systems with Pseudo Local Loops". Testing and Measurement: Techniques and Applications: Proceedings of the TMTA-2015. 16-17 January 2015, Phuket Island, Thailand. Taylor & Francis Group. London. ISBN: 978-1-138-02812-1-8. P. 411 – 416. Typeset by diacriTech, Chennai, India, Published: CRC Press / Balkema. P.O. Box 11320, 2301 EH Leiden, The Netherland. [www.crcpress.com](http://www.crcpress.com), Printed and bond in the UK and US, ISBN 987-1-138-02812-8, 978-1-315-68493-2.

- [13] V.A. Zhmud, L.V. Dimitrov. "Adaptive feedback systems on the base of Concurrent Criteria of Optimum". Automatics & Software Engineering. 2015. № 4 (14). P. 19–25. ISSN 2312-4997.
- [14] V.A. Zhmud. "Control of Object with Linearly Increasing Delay". Automatics & Software Engineering. 2015. № 4 (14). P. 26–34. ISSN 2312-4997.



**Vadim Zhmud**

E-mail: [oao\\_nips@bk.ru](mailto:oao_nips@bk.ru)



**Vladimir Semibalamut**

E-mail: [wladim28@yandex.ru](mailto:wladim28@yandex.ru).



**Lubomir Vankov Dimitrov**

E-mail: [lubomir\\_dimitrov@tu-sofia.bg](mailto:lubomir_dimitrov@tu-sofia.bg)