Design of PID-Regulators for Third-Order Objects with Delay: Comparison of Altair Embed and SimInTech Software

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Abstract. The article set out the task of comparing two software products for the automated design of controllers by the method of numerical optimization, but for reasons understandable from the context of the article, the comparison did not work out correctly. It was assumed that the comparison is carried out on the example of two typical problems, namely: problems of designing a controller for a third-order plant with delay, provided that there is or is not a free term in the denominator of the transfer function. Such objects have fundamentally different responses to a step jump; therefore, all tabular methods will give fundamentally different methods for a problem with a nonzero intercept, but they are not applicable to a problem with a nonzero intercept. Numerical optimization methods have an inherent advantage over tabular methods. This article does not make comparisons with MATLAB because such comparisons have been made before. The SimInTech software product was recently announced by NSTU by representatives of the developer, it has many initial advantages, such as complete openness of the code, which allows the user to easily create new and fairly complex object models, and a large bank of object models is also a significant advantage. Optimization software is also available in this software product. This article discusses some of the problems reported by the company that developed and distributes the second of these software, and speculates about the causes of these problems.

Key words: Automation, cybernetics, controller, PID, controller, optimization, numerical simulation, numerical optimization, VisSim, Altair Embed, SimInTech

References

[1] https://ru.wikipedia.org/wiki/VisSim
[2] https://web.solidthinking.com/vissim-is-now-solidthinking-embed)
[3] Zhmud V., Prokhorenko E., Liapidevskiy A. The design of the feedback systems by means of the modeling and optimization in the program VisSim 5.0/6. В сборнике: proceedings of the IASTED international conference on modelling, identification and control 30th IASTED conference on modelling, identification, and control, ASIAMIC 2010. Сер. “Proceedings of the 30th IASTED conference on Modelling, Identification, And Control, Asiamic 2010” Phuket, 2010. С. 27-32.
[4] Zhmud V.A. Modeling, research and optimization of closed systems. Monograph / Novosibirsk State Technical University. Novosibirsk, 2012. (in Russian).
[5] Zhmud V.A., Zavorin A.N. Metodi di ottimizzazione del controllo numerico su una modelli troncati. Italian Science Review. 2014. № 4 (13). С. 686-689.
[6] Voevoda A.A., Zhmud V.A., Ishimtsev R.Y., Semibalamut V.M. The modeling tests of the new pid-regulators structures. In: Proceedings of the IASTED International Conference on Applied Simulation and Modelling, ASM 2009 18th IASTED International Conference on Applied Simulation and Modelling, ASM 2009. Palma de Mallorca, 2009. С. 165-168.
[7] Voevoda A.A., Zhmud V.A. Convergence of controller optimization algorithms for an object with a limiter and with a delay. Scientific Bulletin of the Novosibirsk State Technical University. 2007. No. 4 (29). S. 179-184. (in Russian).
[8] Zhmud V., Yadrishnikov O., Poloshchuk A., Zavorin A. Modern key techologies in automatics: structures and numerical optimization of regulators. В сборнике: Proceedings - 2012 7th International Forum on Strategic Technology, IFOST 2012 2012. С. 6357804.
[9] Vasiliev V.A., Voevoda A.A., Zhmud V.A., Hassuoneh V.A. Digital controllers: target settings, selection of integration method, hardware implementation. Collection of scientific papers of Novosibirsk State Technical University. 2006. No. 4 (46). S. 3-10. (in Russian).
[10] Zhmud VA, Yadryshnikov O. Numerical optimization of pid-regulators using the detector of the correctness of motion in the target function. Automation and software engineering. 2013. No. 1 (3). S. 24-29. (in Russian).
[11] Zhmud V., Dimitrov L., Yadrishnikov O. Calculation of regulators for the problems of mechatronics by means of the numerical optimization method. В сборнике: 2014 12th International Conference on Actual Problems of Electronic Instrument Engineering APEIE 2014 Proceedings. 2014. С. 739-744.
[12] Zhmud V., Vostrikov A., Semibalamut V. Feedback systems with pseudo local loops. В сборнике: Testing and Measurement: Techniques and Applications - Proceedings of the 2015 International Conference on Testing and Measurement: Techniques and Applications, TMTA 2015 2015. С. 411-417.
[13] Voevoda A.A., Zhmud V.A. Astatic control of objects with non-stationary matrix transfer functions by the method of approximate inversion of functional complex matrices. Scientific Bulletin of the

Novosibirsk State Technical University. 2006. No. 2 (23). S. 3-8. (in Russian).
[14] Zhmud V., Zavorin A. The design of the control system for object with delay and interval-given parameters. В сборнике: 2015 International Siberian Conference on Control and Communications, SIBCON 2015 - Proceedings 2015. С. 7147060.
[15] Zhmud V.A., Zavorin A.N. A method for designing energy-saving controllers for complex objects with a partially unknown model. In the collection: Problems of control and modeling in complex systems. Proceedings of the XVI International Conference. Institute for Management of Complex Systems, Samara Scientific Center of the Russian Academy of Sciences; Edited by: E.A. Fedosova, N.A. Kuznetsova, V.A. Wittich. 2014.S. 557-567. (in Russian).
[16] Zhmud V.A., Goncharenko A.M. Modern problems of high-precision measurements of the phase differences.
В сборнике: Труды XIII Международной Научно-Технической Конференции Актуальные Проблемы Электронного Приборостроения. Proceedings: in 12 volumes. 2016. С. 314-318.
[17] Zhmud V.A., Frantsuzova G.A., Vostrikov A.S. Dynamics of mechatronic systems. Textbook / Novosibirsk, 2014. (in Russian).
[18] Zhmud V.A., Zavorin A.N. Model structure for optimizing a feedback system. Patent for invention RU 2554291 C1, 06.27.2015. Application No. 2014112628/28 of 04/01/2014. (in Russian).
[19] Zhmud V.A., Zavorin A.N., Yadryshnikov O.D. Non-analytical methods for calculating PID controllers (in Russian). Textbook / Novosibirsk, 2013.
[20] http://simintech.ru/ (in Russian).

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