

## METHOD OF CREATING DIGITAL PROJECTS FOR AUTOMATED CONTROL SYSTEMS OF CONSTRUCTION RAILWAY ENGINEERING

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The article describes the methods of creating digital projects for automated control systems, the specifics of creating digital projects and the difference between methodological solutions for railways. The advantages of the developed methodology for digitizing the path with respect to the conversion of design coordinates from the MSC to a new coordinate system to ensure the operation of SAU-3D are shown. The block diagram of creating a digital project based on the digitization of the path using the hardware-software complex "Profile" and design geometric parameters. Examples of using traditional project documentation to obtain initial design data for creating digital projects are shown.

**Key words:** methodology for creating digital projects, coordinate systems, automated control systems, engineering and geodetic support for railroad repairs.

### REFERENCES

1. Verkhovykh, G. V. (2020). Priority tasks of the infrastructure complex. *Zheleznodo-rozhny transport [Railway Transport]*, 2, 52–56 [in Russian].
2. Grinchar, N. G. (2019). Modern and promising lightweight track machines for cleaning the rail-sleeper grid. *Put' i putevye khozyaystvo [Path and Track Facilities]*, 9, 18–21 [in Russian].
3. Ermakov, V. M., & Manuylo, D. S. (2019). Trebovaniya k putevym mashinam dlya realizatsii tsifrovyykh tekhnologiy remonta puti. *Zheleznodorozhnyy transport [Railway Transport]*, 9, 30–33 [in Russian].
4. Ermakov, V. M., Yanovich, O. A., Kosarikova, T. V., & Sherokova, T. M. (2019). The efficiency of the operation of the path in a single coordinate space. *Put' i putevye khozyaystvo [Path and Track Facilities]*, 12, 10–12 [in Russian].
5. Rosenberg, I. N., Dulin, S. K., & Yakushev, D. A. (2018). Mobile laser scanning technologies for railway infrastructure. *Zheleznodorozhnyy transport [Railway Transport]*, 8, 32–35 [in Russian].
6. Code of Practice 233.1326000.2015. (2015). Railway infrastructure High precision coordinate system. Moscow: Federal Agency for Technical Regulation and Metrolog Publ. [in Russian].
7. Shcherbakov, V. V., Kovaleva, O. V., & Shcherbakov, I. V. (2016). Digital track models - the basis of geodetic support for the design, construction (repair) and operation of railways. *Geodeziya i kartografiya [Geodesy and Cartography]*, 3, 12–16 [in Russian].
8. Kulizhnikov, A. M., Anufriev, A. A., & Kolesnikov, I. P. (2014). The regulatory framework for self-propelled guns 3D. *SAPR i GIS avtomobil'nykh dorog [CAD and GIS for Roads]*, 2, 38–41 [in Russian].
9. Raikova, L. S., & Petrenko, D. A. (2014). Construction of roads based on 3D-models. *SAPR i GIS avtomobil'nykh dorog [CAD and GIS for Roads]*, 2(3), 81–85 [in Russian].
10. Skvortsov, A. V. (2014). Regulatory and technical support of BIM roads. *SAPR i GIS avtomobil'nykh dorog [CAD and GIS for Roads]*, 2, 22–32 [in Russian].
11. Topcon Machine Control. 3D systems. (n. d.). Retrieved from <http://www.topconpositioning.com/products/machinecontrol/3d>.
12. Trimble Heavy Civil Construction. Machine Control. (n. d.). Retrieved from <http://construction.trimble.com/products/machine-control>.
13. Order of Russian Railways of January 18, 2013 No. 75r (January 21, 2015) (as amended on December 19, 2018). On approval and implementation of the revised edition of the technical specifications for reconstruction (modernization) and repair of the railway track. Retrieved from ConsultantPlus online database [in Russian].
14. Order of Russian Railways No. 3214 of Desember 31, 2015. Geodetic support for repair (modernization) of the railway using GNSS and automated control systems based on them. Retrieved from ConsultantPlus online database [in Russian].
15. Code of Practice 47.13330.2012. Engineering surveys for construction. The main provisions. Updated edition of SNiP 11.02-96. Retrieved from Garant online database [in Russian].
16. Code of Practice 126.13330.2012. Geodetic works in construction. Updated edition of SNiP

- 3.01-84. Retrieved from Garant online database [in Russian].
17. Shcherbakov, V. V., Pimenov, A. I., Buntsev I. A., & Shcherbakov I. V. (2019). Patent 187173 Russian Federation. Gravel cleaning machine [in Russian].
18. Shcherbakov, V., Buntsev, I., & Kovaleva, O. (2019). Development of a control system for a ballast cleaning machine using GNSS. *E3S Web of Conferences, Innovative Technologies in Environmental Science and Education (ITESE-2019)*, 135(2019), 02003. Retrieved from <https://doi.org/10.1051/e3sconf/201913502003>.
19. Shcherbakov, I. V., Manakov, A. L., Vorobevsky, A. V., Pimenov, A. I., Golubkin, K. V., & Shcherbakov, V. V. (2019). Patent Russian Federation 2703819. The method of automatic quality control of the compaction of the ballast layer of the rail track and a device for its implementation [in Russian].
20. Shcherbakov, V. V., Shcherbakov, I. V., Modestov, A. N., Buntsev, I. A., & Slavkin, V. P. (2015). Patent Russian Federation 2551637. A device for straightening a railway track and a method for straightening a railway track [in Russian].
21. Shcherbakov, V., Karpik, A., & Barsuk, M. (2019). Automation of Railroad Construction Technology Using Surveying Methods. *Advances in Intelligent Systems and Computing, VIII International Scientific Siberian Transport Forum TransSiberia 2019*, 1116(2020). doi: 10.1007/978-3-030-37919-3.
22. Shcherbakov, V. V., Vereskun, V. D., Gerasimov, V. A., Modestov, A. N., & Tarakanov, A. S. (2012). Patent 116862 Russian Federation. A device for determining the spatial parameters of the railway infrastructure [in Russian].
23. Shcherbakov, I. V. (2017). Profile-M Hardware and Software Suite for Determining the Spatial and Geometric Parameters of the Track Gauge. *Vestnik SGUGiT [Vestnik SSUGT]*, 22(3), 45–60 [in Russian].
24. Standards Russian Federation. (2017). GOST 32453–2017. Global Navigation Satellite System. Coordinate systems. Methods for transforming coordinates of defined points. Moscow: Standartinform Publ. [in Russian].
25. Balandin, V. N., Bryn', M. Ya., Ishmenetskiy, S. P., Matveev, A. Yu., & Yus'kevich, A. V. (2006). Algorithm for calculating the geodetic height of spatial rectangular coordinates. *Geodeziya i kartografiya [Geodesy and Cartography]*, 6, 15–16 [in Russian].
26. Zalutsky, V. T. (2017). Improvement of the coordinate transformation algorithm during the transition from the GSK to the MSC of the city and vice versa. *Geodeziya i kartografiya [Geodesy and Cartography]*, 9, 2–7 [in Russian].
27. Kanashin, N. V., & Sukharev, I. I. (2017). Investigation of the accuracy of marks interpolation of the railway longitudinal profile by different methods. *Vestnik SGUGiT [Vestnik SSUGT]*, 22(2), 36–43 [in Russian].
28. Shcherbakov, V. V., Pimenov, A. I., Buntsev, I. A., Sherbakov, I. V., & Kovaleva, O. V. (2015). Development of automated track straightening control systems based on GNSS. *Transportnoe stroitel'stvo [Transport Construction]*, 9, 22–25 [in Russian].
29. Vdovin, V. S., Dvorkin, V. V., Karpik, A. P., Lipatnikov, L. A., Sorokin, S. D., & Steblov, G. M. (2018). Current state and future development of active satellite geodetic networks in Russia and their integration into ITRF. *Vestnik SGUGiT [Vestnik SSUGT]*, 23(1), 45–60 [in Russian].
30. Komyagin, S. A. (2019). Evaluation of the accuracy of statement of the way to the project status with ACS-3D. In *Sbornik materialov Interekspo GEO-Sibir'-2019: Mezhdunarodnoy nauchnoy konferentsii: T. 1, No. 1. Geodeziya, geoinformatika, kartografiya, marksheyderiya [Proceedings of Int-expo GEO-Siberia-2019: International Scientific Conference: Vol. 1, No. 1 [Geodesy, Geoinformatics, Cartography, Mine Surveying]]* (pp. 119–129). Novosibirsk: SSUGT Publ. [in Russian].

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