Investigating the profile passability of the wheeled vehicle by means of the polyhedra intersection algorithm

© A.A. Stadukhin, R.D. Peskov

Bauman Moscow State Technical University, Moscow, 105005, Russia

The article suggests defining the pattern of the interaction between the support base and the wheel of the transport vehicle by means of the Gilbert — Johnson — Keerthi polyhedra intersection algorithm that allows examining the wheeled vehicle's crossing the obstacles of any profile, including the ones with the vertical walls and negative grades. With the view of the simplicity and the computations efficiency increase the suggested technique is restricted by the two-dimensional interaction between the circle of the wheel and the polygon of the road. The article provides the dependencies necessary for finding the forces and torques arising during the interaction between the wheel and the supporting surface. We introduce a simulated computer model, used for the suggested technique. The patterns of simulating the wheeled vehicle motion over the various supporting surfaces are considered. We give recommendations regarding the use of this technique for solving the spatial problem of investigating the profile passability.

Keywords: *profile passability, wheeled vehicles, supporting surface, dynamic simulation, MATLAB, Gilbert — Johnson — Keerthi algorithm*

REFERENCES

[1] Mamiti G.I., Pliev S.Kh., Vasilev V.G. *Izvestiya Gorskogo gosudarstvennogo agrarnogo universiteta — Proceedings of Gorsky State Agrarian University*, 2015, no. 3, pp. 152–157.

[2] Shukhman S.B., Solovev V.I., Malkin M.A. *Nauka i obrazovanie: nauchnoe izdanie — Science and Education of Bauman MSTU*, 2010, no. 11. Available at: http://old.technomag.edu.ru/doc/163675.html (accessed July 13, 2017).

[3] Stadukhin A.A. Modelirovanie kontakta transportnoy mashiny i opornogo osnovaniya kak funktsii vertikalnoy koordinaty [Simulating the contact between the vehicle and the supporting surface as the function of the vertical coordinate]. *Trudy NAMI*. [Collection of scientific articles "TRUDY NAMI"], 2015, no. 262, pp. 65–75.

[4] Gorelov V.A., Komissarov A.I. Matematicheskaya model vzaimodeistviya shiny s tverdymi nerovnostyami opornoy poverkhnosti dlya sluchaya pryamolineynogo kacheniya kolesa [The mathematical model of interaction between the tire and the hard irregularities of the supporting surfaces in case of rectilinear rolling motion of the wheel]. *PROM-INZHINIRING. Trudy II mezhdunarodnoy nauchno-tekhnicheskoy konferentsii FGBOU VPO "Yuzhno-Uralskiy gosudarstvennyy universitet" (natsionalnyy issledovatelskiy universitet)* [Proc. of the 2nd International Conference on Industrial Engineering of the South Ural State University (national research university)]. Chelyabinsk, FGBOU VPO Publ., 2016, pp. 129–133.

[5] Dyakov A.S., Ryazantsev V.I., Ankinovich G.G. *Nauka i obrazovanie: nauchnoe izdanie — Science and Education of Bauman MSTU*, 2014, no. 12. Available at: http://technomag.bmstu.ru/doc/747961.html (accessed July 13, 2017).

[6] Stadukhin A.A. *Inzhenernyy zhurnal: nauka i innovatsii — Engineering Journal: Science and Innovation*, 2016, iss. 12. http://dx.doi.org/10.18698/2308-6033-2016-12-1561

[7] Deng X. *Robot workcell modeling and collision detection with Matlab robotics toolbox. Master of Science Thesis.* Tampere University of Technology, 2012, 53 p.
[8] *Java collision detection and physics engine. dyn4j*. Tag: Collision Detection. Available at: http://www.dyn4j.org/tag/gjk (accessed July 13, 2017).
[9] *Bullet Physics Library. Real-Time Physics Simulation.* Available at: http://bulletphysics.org/wordpress (accessed July 13, 2017).
[10] Kotiev G.O., Gorelov V.A., Zakharov A.Yu. *Nauka i obrazovanie: nauchnoe izdanie — Science and Education of Bauman MSTU*, 2014, no. 4. http://dx.doi.org/10.7463/0414.0707918

Stadukhin A.A., Cand. Sc. (Eng.), Assoc. Professor, Department of Multipurpose Caterpillar Machines and Mobile Robots, Bauman Moscow State Technical University. e-mail: ant.m9@ya.ru

Peskov R.D., student, Department of Multipurpose Caterpillar Machines and Mobile Robots, Bauman Moscow State Technical University. e-mail: pesckov.roma@yandex.ru