Review and analytical article

Questions of choosing a vision system of agricultural robotic systems for weed control

M.A. Shereuzhev[1, 2], M.A. Shereuzhev[3], A.Y. Kishev[1]

[1] Kabardino-Balkarian State Agrarian University named after V.M. Kokov

360030, Russia, Nalchik, 1v Lenin avenue

[2] Institute of Computer Science and Problems of Regional Management –

branch of Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences

360000, Russia, Nalchik, 37-a I. Armand street

[3] Moscow State Technical University named after N. E. Bauman

105005, Russia, Moscow, build. 5 corps 1 Baumanskaya street

Annotation. The tasks of agricultural robotization, in particular, the task of autonomous control of weeds, is associated with the control of transport platforms and working bodies in a non-deterministic environment. Accordingly, the problem arises of formalizing the states of the external environment, including the localization of plants and determining the state of the treated surface. The paper considers the main methods of localization and monitoring of vegetation using sensors as part of a vision system placed on a robotic platform and coupled with an autonomous movement control system.

Key words: weed control, technical vision, agricultural robotics, geographic information systems

REFERENCES

1. Arellano Manuel Vázquez. Crop plant reconstruction and feature extraction based on 3-D vision". Dr.sc.agr. in Agricultural Science. 2019.

2. Åstrand B., Baerveldt A.-J. An Agricultural Mobile Robot with Vision-Based Perception for Mechanical Weed Control. *Autonomous Robots. No.* 13. Pp. 21–35. 2002. https://doi.org/ 10.1023/A:1015674004201

3. Chebrolu N., Lottes Ph., Schaefer A., Winterhalter W. [et al.] Agricultural robot dataset for plant classification, localization and mapping on sugar beet fields. *The International Journal of Robotics Research*. 2017. Vol. 36(10). Pp. 1045–1052. DOI: 10.1177/027836491772051.

4. Jiang Z., Staude W. An Interferometric Method for Plant Growth Measurements. *Journal of Experimental Botany*, 1989. Vol. 40(219). Pp. 1169–1173. http://www.jstor.org/stable/ 23692028

5. Milella A., Reina G., Foglia M. Computer vision technology for agricultural robotics. *Sensor Review*. 2006. Vol. 26. Pp. 290-300. DOI: 10.1108/02602280610692006.

6. Reid John F., Searcy Stephen W. Automatic Tractor Guidance with Computer Vision. *SAE Transactions*. Vol. 96. 1987. Pp. 673–693. http://www.jstor.org/stable/44472830.

7. Reina G., Milella A. Towards Autonomous Agriculture: Automatic Ground Detection Using Trinocular Stereovision. *Sensors (Basel, Switzerland)*. 2012. Vol. 12. 12405-12423. DOI: 10.3390/s120912405.

8. Rovira-Más F., Han Sh., Wei J., Reid J. Autonomous Guidance of a Corn Harvester using Stereo Vision. *Agric. Eng. Int. CIGR Ejournal*. Vol. 9. 2007.

9. Kazmin V.N., Noskov V.P. 3D vision in navigation support system of unmanned aerial vehicle. *Engineering Journal: Science and Innovation.* No. 11(11). P. 40. (in Russian)

Казьмин В. Н., Носков В. П. Объемное зрение в системе навигационного обеспечения беспилотного летательного аппарата // Инженерный журнал: наука и инновации. 2012. № 11(11). С. 40.

10. Muratov E.R., Yukin S.A., Efimov A.I., Nikiforov M.B. Technical point of view sensors: Textbook for institutes and universities, Moscow: Goryachaya liniya – Telekom. 2019. 72 p. (in Russian)

Муратов Е. Р., Юкин С. А., Ефимов А. И., Никифоров М. Б. Сенсоры технического зрения: учебное пособие для вузов. Москва: Горячая линия - Телеком, 2019. 72 с.

11. Noskov V.P., Rubtsov I.V., Vazaev A.V. Efficiency of environment simulation based on interconnected computer vision system. *Robotics and technical cybernetics*. 2015. No. 2(7). Pp. 51–55. (in Russian)

Носков В. П., Рубцов И. В., Вазаев А. В. Об эффективности моделирования внешней среды по данным комплексированной СТЗ // Робототехника и техническая кибернетика. 2015. 2(7). С. 51–55.

12. Noskov V.P., Rubtsov V.I., Rubtsov I.V. *Matematicheskie modeli dvizheniya i sistemy tekhnicheskogo zreniya mobil'nyh roboto-tekhnicheskih kompleksov*: *ucheb. posobie* [Mathematical Models of Motion and Vision Systems of Mobile Robotic Complexes] Moskva: Izd-vo MGTU im. N. E. Baumana. /MSTU n.a. N.E. Bauman Publishing House,2015. 94 p. (in Russian)

Носков В. П., Рубцов В. И., Рубцов И. В. Математические модели движения и системы технического зрения мобильных робототехнических комплексов: учеб. пособие. Москва: Изд-во МГТУ им. Н. Э. Баумана, 2015. 94 с.

Information about the authors

Shereuzhev Marat Arturovich, postgraduate, Department "Agronomy", Kabardino-Balkarian State Agrarian University named after V.M. Kokov;

360030, Russia, Nalchik, 1v Lenin avenue;

Trainee researcher of the Laboratory «Intellectual Habitats» of the Institute of Computer Science and Regional Management Problems – branch of Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences;

360000, Russia, Nalchik, 37-a I. Armand street;

marat.shereuzhev07@mail.ru, ORCID: https://orcid.org/0000-0001-7368-4691

Shereuzhev Madin Arturovich, senior lecturer, Department «Robotic systems and mechatronics», Moscow State Technical University named after N.E. Bauman;

105005, Russia, Moscow, build. 5 corps 1 Baumanskaya street;

shereuzhev@bmstu.ru, ORCID: https://orcid.org/0000-0003-2352-992X

Kishev Alim Yurievich, Candidate of Agricultural Sciences, Associate Professor, Acting Head of the Department "Agronomy", Kabardino-Balkarian State Agrarian University named after V.M. Kokov;

360030, Russia, Nalchik, 1v Lenin avenue;

a.kish@mail.ru, ORCID: https://orcid.org/0000-0003-2838-6876