

SIMULATION MODEL OF AN INTELLIGENT CONTROL SYSTEM FOR THE AGRICULTURAL GRIP MANIPULATOR BASED ON THE MULTI-AGENT NEUROCOGNITIVE ARCHITECTURES TRAINING

Z.V. NAGOEV¹, I.A. PSHENOKOVA², K.CH. BZHIKHATLOV¹, S.A. KANKULOV²

¹ Federal public budgetary scientific establishment «Federal scientific center
«Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences»
360002, KBR, Nalchik, 2 Balkarova str.
E-mail: kbncran@mail.ru

² Institute of Computer Science and Problems of Regional Management –
Branch of Federal public budgetary scientific establishment «Federal scientific center
«Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences»
360000, KBR, Nalchik, 37-a I. Armand str.
E-mail: iipru@rambler.ru

The problem of increasing the efficiency of production and harvesting of fruit, vegetable and berry products has led to the need to develop technologies for unmanned harvesting of fruit and vegetable products. The most important task in the design of an agricultural robot is the task of automatic non-damaging separation of products from plantings of fruit crops. The work presents a prototype of an anthropomimetic manipulator, which is designed in the form of a human hand. A simulation model of an intelligent control system for the grip of an agricultural anthropomimetic manipulator has been developed. The control system is a distributed adaptive learning automatic system (intelligent agent) based on a multi-agent neurocognitive architecture. The process of acquiring by an intelligent agent the knowledge necessary for studying the system "robot manipulator - object of influence" is presented, in particular, the process of setting and tracking the angle of rotation of the gripper fingers articulation, as well as controlling the tension of cables and the load of motors according to data from the sensor system of an agricultural robot.

The results of this study can be used to develop control systems for the manipulator of autonomous robots and robotic systems for agricultural purposes.

Keywords: autonomous robot, agricultural manipulator, intelligent control systems, multi-agent systems, neurocognitive architecture.

REFERENCES

1. *Agrobot: Sel'skokhozyaystvennyye roboty* [Agrobot: Agricultural Robots]: [Elektronnyy resurs]. <https://www.agrobot.com/>
2. Vision Robotics Corporation: [Elektronnyy resurs]. <https://www.visionrobotics.com/>
3. Akhila Gollakota, M. B. Srinivas Agribot - A multipurpose agricultural robot // 2011 Annual IEEE India Conference 16-18 Dec. 2011, DOI: 10.1109/INDCON.2011.6139624
4. Shalova S.Kh., Zagazezheva O.Z. *Obzor rynka sel'skokhozyaystvennykh robotov i ikh vliyaniye na ekonomicheskoye razvitiye* [Review of the agricultural robots market and their impact on economic development] // *Izvestia SFU. Technical science.* 2019. No. 7 (209). Pp. 57–70.
5. Pshenokova I.A., Anchokov M.I., Denisenko V.A. *Formal'naya postanovka zadach intellektualizatsii protsessa robotizirovannogo sbora plodoovoshchnoy produktsii na osnove primeneniya mul'tiagentnykh neyronnykh setey* [Formal setting of tasks for the intellectualization of the process of robotic harvesting of fruits and vegetables based on the use of multi-agent neural networks] // *News of the Kabardino-Balkarian Scientific Center of RAS.* 2017. No. 6-2 (80). Pp. 191–196.

6. Nagoev Z.V. *Intellektika, ili Myshleniye v zhivyykh i iskusstvennykh sistemakh* [Intelligence, or thinking in living and artificial systems]. Nalchik: Publishing House KBSC RAS, 2013. 213 p.

7. Nagoev Z.V., Bzhikhatlov K.Ch., Pshenokova I.A., Nagoeva O.V., Sundukov Z.A., Atalikov B.A., Chechenova N.A., Malyshev D.A. *Avtonomnyy sintez prostranstvennykh ontologiy v sisteme prinyatiya resheniy mobil'nogo robota na osnove samoorganizatsii mul'tiagentnoy neyrokognitivnoy arkhitektury* [Autonomous synthesis of spatial ontologies in the decision-making system of a mobile robot based on self-organization of multi-agent neurocognitive architecture] // News of the Kabardino-Balkarian Scientific Center of RAS. 2020. No. 6 (98). Pp. 68–79.

8. Nagoev Z., Pshenokova I., Nagoeva O., Sundukov Z. Learning algorithm for an intelligent decision making system based on multi-agent neurocognitive architectures // Cognitive Systems Research - Elsevier. V. 66. Pp. 82–88.

9. Nagoev Z., Nagoeva O., Gurtueva I., Denisenko V. Multi-agent algorithms for building semantic representations of spatial information in a framework of neurocognitive architecture // Advances in Intelligent Systems and Computing. 2020. V. 948. Pp. 379-386.

10. Nagoev Z.V., Nagoeva O.V., Pshenokova I.A., Gurtueva I.A. Multi-agent model of semantics of simple extended sentences describing static scenes // Lecture notes in computer science. 2019. Pp. 245–259.

11. Nagoev Z.V., Sundukov Z.A., Pshenokova I.A., Denisenko V.A. *SAPR raspredeleennogo iskusstvennogo intellekta na osnove samoorganizuyushchikhsya neyrokognitivnykh arkhitektur* [CAD architecture of distributed artificial intelligence based on self-organizing neurocognitive architectures] // News of the Kabardino-Balkarian Scientific Center of RAS. 2020. No. 2 (94). Pp. 40–47.

Information about the authors:

Nagoev Zalimhan Vyacheslavovich, Candidate of Technical Sciences, Chairman of Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences.

360000, KBR, Nalchik, 37-a I. Armand str.

E-mail: zaliman@mail.ru

Pshenokova Inna Auesovna, Candidate of Physical-Mathematical Sciences, Head of the Laboratory «Intellectual Habitats» of the Institute of Computer Science and Problems of Regional Management of KBSC of the Russian Academy of Sciences.

360000, KBR, Nalchik, 37-a I. Armand str.

E-mail: pshenokova_inna@mail.ru

Bzhikhatlov Kantemir Chamalovich, Candidate of Physical-Mathematical Sciences, Head of the Laboratory «Neurocognitive Autonomous Intelligent Systems» of the Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences.

360002, KBR, Nalchik, 2 Balkarova str.

E-mail: haosit13@mail.ru

Kankulov Sultan Akhmedovich, trainee researcher of the Laboratory «Intellectual Habitats» of the Institute of Computer Science and Problems of Regional Management of the KBSC of the Russian Academy of Sciences.

360000, KBR, Nalchik, 37-a I. Armand str.

E-mail: skankulov@mail.ru