2023 International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS)

7-9 September 2023, Dortmund, Germany, eISBN 979-83-50358-05-6

Multi-objective based multi-agent decision-making system

Radu MELNIC, Victor ABABII, Viorica SUDACEVSCHI, Oleg SACHENKO, Olesea BOROZAN, Taras LENDIUK

https://doi.org/10.1109/IDAACS58523.2023.10348725

Abstract

Multi-objective decision systems for the management, monitoring and control of complex processes require the application of new methods and models of abstraction and formal description based on intelligent computing structures to ensure optimal overall decision-making. These computing structures can be built on the basis of Multi-Agent systems. In this paper it is proposed the development of a Multi-Objective Based Multi-Agent Decision-Making System that ensures the process of searching for the optimal solution based on genetic algorithms and its application in the decision-making process. The Multi-Agent system features a distributed computing structure consisting of lots of heterogeneous data processing nodes. The functionality of agents is described based on mathematical models and sequence diagram, which explains the interaction between the set of Agents. The structure of the decision-making system is presented on two levels of abstraction: the Multi-Agent level of production and management, and the Information level of communication, storage and data processing.

Keywords: *decision-making, mathematical models, multi-agent system, sequence diagram, smart agriculture*

References:

1. *L.C. Jain and C.P. Lim, Handbook on Decision Making. Vol 1: Techniquie and Applications, Springer, pp. 548, 2010. Google Scholar*
2. *J. Lu, L.C. Jain and G. Zhang, Handbook on Decision Making. Vol 2: Risk Management in Decision Making, Springer, pp. 456, 2012. Google Scholar*
3. *M.J. Kochenderfer, Decision Making Under Undertainty: Theory and Application, MIT*

Press, pp. 350, 2015, ISBN 978-0-262-02925-4. CrossRef Google Scholar

4. *K. Takemura, Behavioral Decision Theory: Psychological and Mathematical Descriptions of Human Choice Behavior, Springer, pp. 210, 2014. CrossRef Google Scholar*
5. *M. Kaufman, Local Decision-Making in Multi-Agent Systems, 2010. CrossRef Google Scholar*
6. *U. Wilensky and W. Rand, An Introduction to Agent-Based Modeling: Modeling Natural Social and Engineering Complex Systems with NetLogo, MIT Press, pp. 505, 2015, ISBN 978-0-262-73189-8. Google Scholar*
7. *N. Guanantara, "A Reviev of Multi-Objective Optimization: Methods and its Applications", Cogent Engineering, vol. 5, no. 1502242, pp. 15, 2018. CrossRef Google Scholar*
8. *D. Simon, Evolutionary Optimization Algorithms: Biologicaly-Inspired and Population-Based Approaches to Computer Intelligence, Wiley, pp. 726, 2013, ISBN 978-0-470-93741-9. Google Scholar*
9. *K. Deb, Multi-Objective Optimization using Evolutionary Algorithms, Wiley, pp. 497, 2001, ISBN 0-471-87339-X. Google Scholar*
10. *H.P. Benson, "Multi-objective optimization: Pareto optimal solutions properties" in Encyclopedia of Optimization, Boston:Springer, pp. 2478-2481, 2009. CrossRef Google Scholar*
11. *R.S. Burachik, C.Y. Kaya and M.M. Rizvi, "A new scalarization technique to approximate Pareto fronts of problems with disconnected feasible sets", J. Optim. Theory Appl., vol. 162, no. 2, pp. 428-446, 2014. CrossRef Google Scholar*
12. *B.K. Tripathy and J. Anuradha, Internet of Things: Technologies Applications Challenges and Solutions, CRC Press, pp. 334, 2018, ISBN 978-1-138-03500-3.Google Scholar*
13. *S. Cirani, G. Ferrary, M. Picone and L. Veltri, Internet of Things: Architectures Protocols and Standards, Wiley, pp. 383, 2019, ISBN 978-1-119-35968-5. Google Scholar*
14. *T.J. Devadas, "A survey on agent learning architecture that adopts internet of things and wireless sensor networks", International Journal of Wavelets Multiresolution and Information Processing, vol. 20, no. 2, pp. 2030002, 2022. CrossRef Google Scholar*
15. *S. Lin, Y. Xiu, J. Kong, Ch. Yang and Ch. Zhao, "An Effective Pyramid Neural Network Based on Graph-Related Attentions Structure for Fine-Grained Disease and Pest Identification in Intelligent Agriculture", Agriculture, vol. 13, no. 567, pp. 21, 2023. CrossRef Google Scholar*

16. L. Sun, H. Sun, N. Cao, X. Han, G. Cao, W. Huo, et al., "Intelligent Agriculture Technology Based on Internet of Things", Intelligent Automation & Soft Computing, vol. 32, no. 1, pp. 429-439, 2022. CrossRef Google Scholar

17. Xi Ma, "Smart Agriculture and Rural Revitalization and Development Based on the Internet of Things under the Background of Big Data", Sustainability, vol. 15, no. 3352, pp. 14, 2023. CrossRef Google Scholar

18. S.K. Balasundram, R.R. Shanshiri, Sh. Sridhara and N. Rizan, "The Role of Digital Agriculture in Mitigating Climate Change and Ensuring Food Security: An Overview", Sustainability, vol. 15, no. 5325, pp. 23, 2023. CrossRef Google Scholar

19. A. Mehmood, M. Ahmad and Q.M. Ilyas, "On Precision Agriculture: Enhanced Automated Fruit Disease Identification and Classification Using a New Ensemble Classification Method", Agriculture, vol. 13, no. 500, pp. 20, 2023. CrossRef Google Scholar

20. R. Misara, D. Verma, N. Mishra, Sh.K. Rail and S. Mishra, "Twenty two years of precision agriculture: a bibliometric review" in Precision Agriculture, Springer, vol. 23, pp. 2135-2158, 2022. CrossRef Google Scholar

21. S. Munteanu, V. Sudacevschi, V. Ababii, O. Borozan, C. Ababii and V. Lasco, "Multi-Agent Decision Making System based on Membrane Computing", The 11th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications, vol. 2, pp. 851-854, 22–25 September, 2021, ISBN 978-1-6654-4210-7. View Article Google Scholar

22. A. Turcan, O. Borozan, V. Ababii, V. Sudaevschi and S. Munteanu, "Decision Making System based on Collaborative Agents", Proceedings of the 12th International Conference on Electronics Communications and Computing (ECCO-2022), pp. 257-260, 20–21 October, 2022, ISBN 978-9975-45-898-6. CrossRef Google Scholar

23. O. Dunets, C. Wolff, A. Sachenko, G. Hladiy and I. Dobrotvor, "Multi-agent system of IT project planning", 2017 9th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS), pp. 548-552, 2017. View Article Google Scholar

24. M. Dyvak, A. Melnyk, A. Kovbasistyi, R. Shevchuk, O. Huhul and V. Tymchyshyn, "Mathematical Modeling of the Estimation Process of Functioning Efficiency Level of Information Web-Resources", 2020 10th International Conference on Advanced Computer Information Technologies (ACIT), pp. 492-496, 2020. View Article Google Scholar

25. M. Dyvak and A. Pukas, "Criterion of design of experiments for tasks of decision support interval model creation", Proceedings of the 2005 IEEE Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications, pp. 495-497, 2005. View Article Google Scholar

26. *M. Dyvak, O. Papa, A. Melnyk, A. Pukas, N. Porplytsya and A. Rot, "Interval model of the efficiency of the functioning of information web resources for services on ecological expertise", Mathematics, vol. 8, no. 12, pp. 2116, 2020.* *CrossRef Google Scholar*