РЕЗЮМЕ НА НАУЧНИТЕ ТРУДОВЕ

за участие в конкурс за заемане на академичната длъжност „доцент“ на гл. ас. д-р Иван Станимиров Стоянов

За участие в настоящия конкурс (вж. Списък на научните трудове за участие в конкурса) са избрани 12 публикации и 1 книга (монография). От избраните за участие в настоящия конкурс 5 публикации са в списания, 7 статии са индексирани в базата данни Web of Science, 6 статии са индексирани в базата данни Scopus, 1 с SJR, 3 с IF, 2 в Q1, 1 в Q3 и 1 в Q4.

1. V. Tabakova-Komsalova, L. Doukovska, **I. Stoyanov**, J. Todorov, S. Stoyanov and Z. Radeva, "ViSMod – An Environment for Modeling of Scenarios and Processes in Intelligent Agriculture," 2021 Big Data, Knowledge and Control Systems Engineering (BdKCSE), Sofia, Bulgaria, 2021, pp. 1-6, doi: 10.1109/BdKCSE53180.2021.9627313. (SCOPUS, WoS)

In this paper, an environment for modeling scenarios and processes in intelligent agriculture settings, known as ViSMod, is presented. ViSMod is developed as an expert system the architecture of which is also given in the article. The use of the environment
is demonstrated by an example - a system for diagnosing possible poisoning of ruminants.

2. V. Tabakova-Komsalova, S. Stoyanov, L. Doukovska, **I. Stoyanov** and S. Cherecharov, "Personal Assistant Supporting Diagnosis of Livestock Poisoning," 2022 International Conference Automatics and Informatics (ICAI), 2022, IEEE Xplore, pp. 189-192, doi:10.1109/ICAI55857.2022.9960100. (SCOPUS)

This paper presents a personal assistant that is able to support veterinarians in diagnosing livestock poisoning. The assistant is implemented as an intelligent agent on top of ZEMELA platform. ZEMELA provides an infrastructure for integration of the physical and virtual worlds that can be used for development of smart agriculture applications. The architecture of the assistant is also presented in the paper. Furthermore, the assistant’s operation is demonstrated by a small example.

3. V. Tabakova-Komsalova, S. Stoyanov, A. Stoyanova-Doycheva, **I. Stoyanov,** L. Doukovska and A. Dukovski, "An Expert System for the Diagnosis of Livestock Poisoning," 2023 International Conference Automatics and Informatics (ICAI), Varna, Bulgaria, 2023, pp. 459-463, doi: 10.1109/ICAI58806.2023.10339064. (SCOPUS)

In recent years, artificial intelligence systems have become increasingly attractive for use in agriculture. Diagnostic expert systems are designed to determine the nature of various deviations from the usual course of biological or technical processes based on a set of symptoms. Although the first diagnostic expert systems appeared in the late 60s and early 70s of the 20th century, diagnostics remains an interesting domain for artificial intelligence. In this paper, we present an expert system that aims to assist veterinarians and farmers in the diagnosis of livestock poisoning. Our preliminary studies show that due to the wide variety of poisonings and their symptoms, the diagnosis of poisonings is a particularly difficult task, and providing such a system would be useful. Furthermore, the system architecture is presented and its use is demonstrated by an example in this paper. The system is implemented by Flex and VisiRule development tools.

4. Stoyanov, I., Tabakova-Komsalova, V., Stoyanova-Doycheva, A., Stoyanov, S., & Doychev, E. (2025). Integration of Software Platforms Based on Secondary Air Quality Standards. BRAIN. Broad Research In Artificial Intelligence And Neuroscience, 16(2), 390-408. doi:http://dx.doi.org/10.70594/brain/16.2/28 (ISSN 2067-3957), (WoS), IF = 0.6, **Q4**

This article presents the design and implementation of an integrated software platform that connects air quality monitoring systems with smart farming tools, focusing on secondary air quality standards. The study investigates the correlation between air pollution and tomato crop development in the Plovdiv region of Bulgaria.

5. J. Todorov, S. Stoyanov, V. Tabakova-Komsalova**, I. Stoyanov**, A. Stoyanova-Doycheva and K. Wassilew, "Agent-based Air Monitoring Platform," 2025 International Conference on Big Data, Knowledge and Control Systems Engineering (BdKCSE), Bankya, Bulgaria, 2025, pp. 1-8, doi: 10.1109/BdKCSE67969.2025.11300518 (WoS)

This paper presents an agent-oriented architecture for air quality monitoring, called AIRGuard, which integrates concepts from Multi-Agent Systems (MAS), event-driven architectures, and semantic ontologies. The architecture is implemented on top of the Jadex BDI platform and integrated into a Spring Boot environment with an Android client. The main active components are three BDI agents – CorrespondentAgent, OntologyAgent, and DatabaseAgent – which perform parallel processing of subtasks, including retrieving regulatory thresholds from an OWL-based ontology and empirical observations via an external REST API. A formal event model is introduced to define atomic and complex events for parameters such as PM10 and PM2.5, enabling the application of rules for exceedance detection and long-term averaging. The proposed architecture demonstrates high modularity, interoperability, and resilience, while facilitating the integration of additional agents and predictive mechanisms.

6. Stoyanov, S.; Doychev, E.; Stoyanova-Doycheva, A.; Tabakova-Komsalova, V.; **Stoyanov, I**.; Nedelchev, I. A Regional Multi-Agent Air Monitoring Platform. *Future Internet* **2025**, *17*, 112. https://doi.org/10.3390/fi17030112, **Q1,** IF = 4.6

Plovdiv faces significant air pollution challenges due to geographic, climatic, and industrial factors, making accurate air quality assessment critical. This study presents a hybrid multi-agent platform that integrates symbolic and sub-symbolic artificial intelligence to improve the reliability of air quality monitoring. The platform features a BDI agent, developed using JaCaMo, for processing real-time sensor measurements and a ReAct agent, implemented with LangChain, to incorporate external data sources and perform advanced analytics. By combining these AI approaches, the platform enhances data integration, detects anomalies, and resolves discrepancies between conflicting air quality reports. Furthermore, its scalable and adaptable architecture lays the foundation for future advancements
in environmental monitoring. This research represents the first stage in developing
an AI-powered system that supports more objective and data-driven decisio making for air quality management in Plovdiv.

7. Stoyanov, S.N.; Belichev, B.L.; Tabakova-Komsalova, V.V.; Todorov, Y.G.; Golev, A.A.; Maglizhanov, G.K.; **Stoyanov, I.S**.; Stoyanova-Doycheva, A.G. Building a Regional Platform for Monitoring Air Quality. Future Internet 2026, 18, 78. https://doi.org/10.3390/fi18020078, https://www.mdpi.com/1999-5903/18/2/78 , **Q1,** IF = 4.6

This paper presents PLAM (Plovdiv Air Monitoring)—a regional multi-agent platform
for air quality monitoring, semantic reasoning, and forecasting. The platform uses a
hybrid architecture that combines two types of intelligent agents: classic BD (Belief-Desire- Intention) agents for complex, goal-oriented behavior and planning, an ReAct agents based on large language models (LLM) for quick response, analysis, and interaction with users. The system integrates data from heterogeneous sources, including local IoT sensor networks and public external services, enriching it with a specialized OWL ontology of environmental norms. Based on this data, the platform performs comparative analysis, detection of anomalies and inconsistencies between measurements, as well as predictions using machine learning models.

8. Tabakova-Komsalova, V., **Stoyanov, I.,** Kostadinova-Tzankova, L., Dukovski, A., Ivanova, T.. Prolog Education in Selected High Schools in Bulgaria. Proceedings of the IEEE International Conference Automatics and Informatics – ICAI'23, 5-7 October 2023, Varna, Bulgaria, IEEE Xplore, 2023, DOI:10.1109/ICAI58806.2023.10339097, 481-484 (SCOPUS)

2022 marks the 50th anniversary of the logic programming language Prolog. In this regard, the authors will join the international initiative known as "Prolog Education and Thinking". The initiative aims to acquaint students mainly with logical programming and Artificial Intelligence through the Prolog language. The article presents shortly the project called "Digital Bulgaria in Prolog", with which we want to join the above-mentioned initiative. The main topic and the architecture of the supporting software are also presented. Furthermore, the beginning and the current state of the introduction of artificial intelligence education in two Bulgarian schools are briefly discussed.

9. Iliya Nedelchev, Veneta Tabakova-Komsalova, **Ivan Stoyanov**, Stanimir Stoyanov, Vanya Ivanova, Tsvetomira Kazashka, Supporting Digitization of a Cultural and Historical Heritage Platform, International Conference Automatics and Informatics (ICAI), Varna, Bulgaria, **2024**, (WoS)

The article introduces a platform designed for the storage and retrieval of digitized cultural and historical objects from Bulgaria. To enhance the platform's accessibility for tourists, a dedicated tourist guide has been created and implemented as a personalized assistant. The architecture, along with its distinct components, is thoroughly elucidated. The article provides an overview of the current state of the platform, details the experiments conducted

with the realized prototype, and outlines its future development, with a focus on integrating cultural and historical object ontologies. Additionally, a brief background of the platform is provided for context.

10. Veneta Tabakova-Komsalova, **Ivan Stoyanov**, George Cholakov, Magdalena Maglizhanova**,** Introducing Artificial Intelligence to Secondary Schools Through STEM Learning and the Logic Programming Language Prolog, TEM Journal. Volume 13, Issue 4, Pages 3221-3230, ISSN 2217-8309, DOI: 10.18421/TEM134-56, November 2024, https://www.temjournal.com/content/134/TEMJournalNovember2024_3221_3230.pdf, (WoS), **Q3**, SJR = 0.231

This article proposes a project aimed at introducing secondary school students to artificial intelligence and logic programming using the Prolog language. In commemoration of the 50th anniversary of Prolog's development, the authors participate in the international initiative "Prolog Education and Thinking" through the "Digital Bulgaria in Prolog" activity, implemented in Bulgarian secondary schools. The article offers a concise overview of a STEM (Science, Technology, Engineering, and Mathematics) educational program and training for secondary school students in Bulgaria. STEM serves as a project-based learning approach, fostering students' understanding of multiple disciplines and utilizing diverse technologies to enhance their skills. Additionally, the article showcases examples of student initiatives spanning natural sciences, informatics, humanities, culture, and art, illustrating the interdisciplinary nature of STEM education.

11. Todorka Glushkova, Stanimir Stoyanov, Lyubka Doukovska, Jordan Todorov, **Ivan Stoyanov**. Modeling of an irrigation system in a virtual physical space [J]. Mathematical Biosciences and Engineering, 2021, 18(5): 6841-6856. doi: 10.3934/mbe.2021340, SJR (Scopus):0.509 **Q2 (Scopus)**

One of the major challenges that smart agriculture is expected to address is the efficient use of water resources. The conservation and the efficient use of clean water is a long term strategy worldwide. Modeling of smart agriculture systems is an important factor because the processes there are very slow and sometimes it takes a year or more for a full crop cycle. At the same time, a large amount of data is usually needed to make informed decisions. This determines the importance of developing appropriate systems through which to simulate, generate, optimize and analyze various possible scenarios and prepare appropriate plans. In this paper, an infrastructure known as Virtual

Physical Space adapted for agriculture is presented. The space supports integration of the virtual and physical worlds where analysis and decision making are done in the virtual environment and the state of the physical objects (things) of interest is also taken into account at the same time. Special attention is paid to the possibilities for modeling an irrigation system. An ambient oriented approach has been adopted, using the Calculus of Context aware Ambients formalism as the basic tool for modeling agriculture processes. Furthermore, the supporting platform is briefly presented. Active components of the platform are implemented as intelligent agents known as assistants. Users (agriculture operators) are serviced by personal assistants. Currently, the presented modeling system is deployed over a two layered system infrastructure in the region of Plovdiv city. Plovdiv is the center of vegetable production in Bulgaria. The process of modeling intelligent irrigation systems and the current results are discussed in this paper.

12. **Ivan Stoyanov**, Boyan Belichev, Veneta Tabakova-Komsalova, Stanimir Stoyanov, Asya Stoyanova-Doycheva, Event model for agent-oriented platforms, IEEE Intelligent Systems IS'26, Varna, Bulgaria, September 3-5, 2026 (WoS)

The article presents the current version of a basic event model, designed to support the construction of agentoriented platforms and applications. The model uses a simplified formal representation of events, a hierarchical classification of basic, system and domain events, as well as groups of operators and predicates for specifying complex event expressions. Mechanisms for event accumulation and memory, priority management, temporal and spatial dependencies and context validity are introduced. The general interpretation of the modelthrough ECOS (Event-driven Context-Oriented Server) is also presented, which is being developed as a multi-agent system for analysis, verification and planning of reactions to planned and incident events. This revised version additionally positions the model relative to event-calculus and complex-event-processing approaches, clarifies the relation between the triple-based event representation and its basic-event shorthand, and adds a worked illustrative example from the smart-agriculture application.

13. **Иван Стоянов,** Изследвания за създаване на виртуален оператор в инфраструктура за интелигентно земеделие. Дисертационен труд за присъждане на образователна и научна степен „доктор", Пловдивски университет „Паисий Хилендарски", Пловдив, 2023.

The dissertation focuses on smart farming—a topic that is increasingly becoming a subject of theoretical research and practical development. The primary objective of the dissertation is to develop a personal assistant (PA) to support farmers and agricultural specialists working within the smart farming environment. The PA is designed to operate as the core of the ZEMELA platform. The theoretical foundation of the PA is the event-based model proposed in the dissertation.

14. Станимир Стоянов, Венета Табакова-Комсалова, Емил Дойчев, Любка Дуковска, Ирина Радева, Сотир Сотиров, **Иван Стоянов**, Атанас Дуковски, ИЗКУСТВЕН ИНТЕЛЕКТ В 24 .../книга трета, Издателство на БАН „Проф. Марин Дринов“, 2024, София, ISBN: 978-619-245-470-8, Обем 804 страници.

The third book in the "Artificial Intelligence in 24..." series is dedicated to the field of machine learning and its closely related disciplines—big data science and the recently prominent blockchain technology. Artificial intelligence is a scientific field finding an increasing number of practical applications and branching out into a growing variety of forms. Therefore, in this third book, we aim to provide a possible classification of the field of artificial intelligence and to outline the characteristics of its various types, specifically machine learning and generative AI. The related fields of big data and blockchain technology are also examined.

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