Review

concerning a contest for obtaining an academic position "Assoc. Professor" in the area of higher education 5. Technical sciences in the professional field 5.2 „Electrical Engineering, Electronics and Automation" in the scientific specialty „ Elements and Devices of Automation and Computing Technology " announced in State Gazette (SG) 39/13.05.2025, for the needs of Section "Control of Robots and Mechatronic Systems" at the Institute of Robotics – Bulgarian Academy of Sciences (BAS)
with candidate **Assistant Prof. Vanya Dimitrova Markova, PhD**

by Assoc. Prof. Sevil Ahmed-Shieva, PhD, Technical University of Sofia

1. General provisions and biographical data

For the participation in the competition are presented documents by Assist. Prof. Vanya Markova, PhD, Technical University of Sofia, Faculty of Electronics and Automation. All documents were submitted on time and comply with the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, its implementing regulations, and the internal rules of BAS and the Institute of Robotics for occupying the academic position of Associate Professor.

Dr. Markova was born on October 13, 1965. In 1987, she graduated with a degree in Mathematics and a specialization in Informatics from Paisii Hilendarski University of Plovdiv. Her diploma thesis was titled "Indirect Command Files for PDP 11: Development and Application." In 2013, she defended her doctoral dissertation titled "Methods and Algorithms for Describing the Behavior of an Autonomous Mobile Sensor Agent" at the Institute of System Engineering and Robotics – BAS, earning the degree of Doctor in the specialty "Elements of Automation and Computing Technology."

Her professional career at BAS began in 2001. Between 2001 and 2008, she worked as a Researcher at the Institute of Management and Systems Research – BAS, focusing on mathematical statistics, forecasting, decision-making. In 2008, she was appointed Assistant at the Institute of System Research and Robotics – BAS, combining this role with research in autonomous agent behavior, machine learning, and decision-making until 2013.

Since earning her doctoral degree, Dr. Markova has been working as a Senior Assistant and Researcher at the Institute of Robotics – BAS, URSM section, focusing on collective robot control, multi-agent systems, and machine learning.

She also has teaching experience as a part-time lecturer at the Technical University of Sofia, where she taught courses such as Systems Analysis, XML Technologies, Artificial Intelligence and Robotics, Advanced Machine Learning, Introduction to Deep Learning, and Applied Deep Learning (2018–2025).

2. Overall characteristic of the applicant's research and scientific applied activity

The candidate submitted 31 peer-reviewed scientific publications (all in English), excluding her dissertation. Among them, 10 publications are indexed in globally recognized scientific databases and qualify as habilitation work. Fourteen of the publications are indexed in Scopus (13) and Web of Science (1). Four are single-author papers; the remaining 27 are co-authored, with no authorship contribution protocols provided.

The submitted publications have been cited 24 times in indexed journals or monographs. Five of the publications have citations; no citations were found in peer-reviewed monographs or non-indexed journals. One citation refers to a publication not included in the competition materials, and there is one self-citation. This affects the score under Indicator 12 in Group D, but the candidate still meets the requirement with 240 points (minimum required: 50). A Scopus check as of September 15, 2025, shows 40 citations, indicating high relevance and scientific impact.

Between 2018 and 2025, the candidate participated in three research projects not listed under the corresponding indicator group:

- BG05M2OP001-1.002-0023: Centre of Competence "Smart Mechatronic, Eco- and Energy Saving Systems and Technologies" - "Collective Robotics" lab (2018–2023)
- BG06RDNP001-16.003-0013: Development and implementation of an electronic tracking system for small ruminants (2024–2025)
- Horizon 2020 – Marie Curie Project (2000)

The submitted materials exceed the minimum requirements for the position of Associate Professor according to the regulations of BAS and the Institute of Robotics.

The scientific contributions of Assist. Prof. Vanya Markova and corresponding evaluation according to the regulations cited above, are given in the following table:

	Points
Group A Indicator 1. PhD Dissertation	**50** (*minimum 50 points*)
Group C Indicator 4. *Habilitation work – scientific publications (at least 10) in journals indexed in globally recognized scientific databases*	**330** (*minimum 100 points*)
Group D Indicators 7 и 8 ✓ *Publications in specialized scientific editions indexed in world-renowned databases Scopus and Web of Science;* ✓ *Publications not indexed in world-renowned databases.*	**240** (*minimum 200 points*)
Group E Indicator 12 ✓ *Citations in scientific publications, referenced and indexed in world-famous databases (5 of the presented publications are cited in 27 publications in scientific publications)*	**240** (*minimum 50 points*)
Total	**860** (*minimum 400 point*)

3. General characteristics of the candidate's scientific research and applied scientific activity

The candidate possesses extensive research experience in the fields of reinforcement learning, deep machine learning, consensus protocols, and control of collectives of autonomous agents and robots.

A central focus of Dr. Vanya Markova's work is on multi-agent systems, including their investigation, modeling, and simulation. Her publications in this area address both the behavior of individual agents and their interactions in collective and individual tasks. The research emphasizes the close relationship between theoretical models and their implementation in simulated environments, which is a key prerequisite for generating both fundamental and applied scientific results in the domain of autonomous robotic systems.

In addition, Dr. Markova presents publications that explore modern methods and approaches employing various techniques based on learning, aimed at acquiring knowledge and/or determining parameter values within control algorithms.

4. Main scientific and applied contributions

Dr. Markova has reach research experience in reinforcement learning, deep learning, consensus protocols, and control of autonomous agents and robots. Her work focuses on multi-agent systems, their modeling and simulation, and the interaction between agents in both individual and collective tasks. The publications demonstrate a strong link between theoretical models and their implementation in simulated environments.

Her contributions are grouped into three thematic areas: *1. Formation and control of collectives of autonomous agents and robots; 2. Joint learning and strategy development through reinforcement learning and knowledge transfer; 3. Behavior modeling and prediction of autonomous agents using deep learning methods.*

4.1. Scientific contributions

Most significant contributions in this group are:

- Development and application of encoder-decoder and sequence-to-sequence models for agent behavior in dynamic environments
- Novel methods for group initialization in autonomous robot collectives using unsupervised learning in geometric graphs
- Formalization of knowledge transfer via Markov Decision Processes (MDP) with precise mathematical definitions of transition and reward functions
- Consensus algorithm development for multi-agent systems

4.2. Scientific-Applied Contributions

- Application of Hungarian assignment algorithms for role and position distribution in robot formations
- Adaptive Deep RL approach for autonomous robot collective formation
- Framework for autonomous mobile agents with embedded meta-learning capabilities
- New approaches for nonlinear system identification
- Hybrid methods using Artificial Potential Fields (APF) and Refined Particle Filter for swarm control in obstacle-rich environments
- Offline knowledge transfer system between agents
- Mathematical modeling of non-holonomic mobile robot dynamics in collective formations.

5. Significance of the contributions to the science and practice

I have no reason to doubt the personal contribution of Dr. Markova to the submitted materials. All contributions are scientifically and practically significant and align with current technological trends.

6. Critical remarks and recommendation

I have no critical remarks regarding the submitted materials. However, official documentation of her participation in the mentioned research projects and teaching activities at TU-Sofia is missing. I recommend that Dr. Markova continue her research toward implementing her proposed approaches in real-world systems, particularly in collective robotics.

7. Personal impressions and opinion of the reviewer

I know the candidate professionally as a part-time lecturer at the Department of Control Systems, Faculty of Electronics and Automation, TU-Sofia, Plovdiv Branch. Dr. Markova is highly committed to the educational process and presents course material with diligence.

CONCLUSION

According to the presented documents and the above analysis of the candidate's work, as well as on my personal conviction, I believe that Assist. Prof. Vanya Markova, PhD, has sufficient scientific and applied contributions.

Finally, Based on the submitted materials, the scientific and applied contributions, and compliance with the requirements of the Law on Academic Staff Development and the regulations of BAS and the Institute of Robotics, I give a positive comprehensive evaluation for Senior Assistant Dr. Eng. Vanya Dimitrova Markova to be appointed to the academic position of Associate Professor in Professional Field 5.2 Electrical Engineering, Electronics and Automation, Scientific Specialty "Elements and Devices of Automation and Computing Technology."

16.09.2025
Plovdiv

Reviewer:
(Assoc. Prof. Sevil Ahmed-Shieva)