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Editorial

Special Issue on Multi-Agent Systems

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1. Introduction

Multi-agent systems (MAS) are a class of systems in which multiple agents interact with each other and their environment to achieve a common or individual goal. Intelligent-agent-based systems are important because they allow for the creation of more flexible and adaptable systems that can effectively deal with complex and dynamic environments, and can improve their performance through learning and interaction with their surroundings. Multi-agent systems are used in a wide range of applications, such as simulation, industrial process control, smart cities, and cyber-physical systems, among others. One of the main advantages of multi-agent systems is their ability to adapt and make real-time decisions in dynamic and changing environments. Examples of multi-agent systems include distributed sensor networks, air-traffic control systems, and automated negotiation systems. In these systems, each agent has its own decision-making logic and can interact with other agents through a common communication platform.

Overall, multi-agent systems are a powerful tool for addressing complex and distributed problems, and their use is increasingly prevalent in a variety of fields. This Special Issue on multi-agent systems presents 21 papers covering various key aspects in this area. First, a fundamental aspect of the development of multi-agent systems is the concept of interaction. Based on the need for interaction between intelligent computational entities, several works are proposed in this Special Issue. The work presented in [1] focuses on the problem of multi-agent tracking, where several tracking agents have to cooperate and interact with each other to track a maneuvering target. Related to tracking, but, in this case, of people, the work presented in [2] introduces a simple model to study the formation of lanes in crowds of individuals moving in opposite directions. Another related work is presented in [3], which addresses the multi-target binary classification problem by employing an ensemble of classification agents. Additionally, [4] presents a review regarding self-interested, non-cooperative agents. Specifically, the work focused on all the phases needed for non-cooperative, multi-agent planning environments.

The formation of virtual organizations, such as groups or teams of agents, is another key aspect in the development of new proposals in multi-agent systems. In that sense, the work presented in [5] addresses the problem of multi-agent system design for organisations of agents acting in dynamic and uncertain environments, and demonstrates that the increased design time guidance available through the specification of organisational constructs and policies yields runtime flexibility in agent action. Another example is the work presented in [6], which proposes a Multiple Criteria Decision Analysis Framework that intends to overcome the limitations observed in group decisio- making. In [7], a novel method to simulate the realistic behavior of groups moving in a specific formation in a virtual environment, including other groups and obstacles, is presented. The formation problem is also considered in [8], which presents a control method for the formation problem of multi-robot systems. Lastly, in [9], a distributed, event-triggered control strategy

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is proposed to investigate the flocking problem in a multi-agent system. Flocking can be regarded as another form of cooperative control or group formation in MAS.

The allocation of tasks or resources in distributed environments is another topic covered in this Special Issue. Specifically, the work presented in [10] proposes a computational resource distribution model to be used in distributed environments, which is capable of managing resources according to past experiences, and dynamically adjusting the resources allocated to each agent. Moreover, in [11], the authors focus on task allocation, in which a task allocation problem model, using agricultural plant protection environment as an example, is established.

Affective computing is another hot topic in the area, which focuses on the detection and integration of emotions in agents' decision-making processes. Within this topic, in [12], a framework is proposed that considers the incorporation of artificial somatic markers at different phases of autonomous agents' decision-making. Moreover, in [13] a review of works regarding the prevention of the risks that can arise from social interaction in online environments is presented, focusing on MAS technologies.

Other papers presented in this Special Issue explore other interesting topics, such as consensus-based systems, as in the case of the work presented in [14], which performs a detailed robustness analysis considering parametric uncertainty and time delays in a multi-agent system to guarantee consensus in a specific domain. In addition, the work presented in [15] is related to the area of argumentation in MAS. The work proposes an argumentation-based approach as a recommender system for learning objects, which selects those learning objects that allow for a greater number of arguments to be generated, to justify their suitability.

The relationship between machine learning and multi-agent systems is another hot topic at present. The combination of both approaches allows for the creation of intelligent systems that can adapt and improve their performance through experience and interaction with their environment and other agents. In this sense, the work presented in [16] employs reinforcement learning to propose a framework that can be used to learn the problems of competitive network topologies, wherein the environment dynamically changes.

Finally, some works focus on the development of specific solutions in particular domains. Such is the case of [17], which deals with the distributed fault detection problem in heterogeneous multi-agent systems. Another application is presented in [18], where a multi-agent system is proposed to collect the data from sensors located in a smart-home and obtain the best action to perform in a central heating system. In [19], a model is proposed that identifies, locates and rates people in the business domain who are capable of resolving a labor incident logged by a user employed by the company. In [20], the authors propose a framework, called Agent Quality Management, to manage agent quality in agent systems. The framework is used in a smart city application to crowdsource navigation systems to verify and assess agent data confidentiality. Another example is the work proposed in [21], where an MAS is designed to help dependent and/or visually disabled people to count money more easily using a mobile phone camera. Lastly, in [22], an optimization-based solution is applied to simulate anti-submarine, high-value unit escort missions.

As can be seen, there are a multitude of topics and application areas for multi-agent systems. Although submissions for this Special Issue have closed, in-depth research in the field of multi-agent systems continues to address the numerous challenges we face at present, such as industry 4.0, remote healthcare, smart cities or smart agriculture.

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