Editorial

Intelligent Systems in Context-Based Distributed Information Fusion

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Information fusion has become increasingly relevant during the last years. One of the reasons is the growing importance as rapid advances in sensor technology that provide information from the environment. The distributed sensor networks can be used to enable information fusion applications in different environments such as surveillance, home care, and sport analysis. With the continuing expansion of the domain of interest and the increasing complexity of the collected information, intelligent techniques for fusion processing have become a crucial component in information fusion applications.

The problem of information fusion has attracted significant attention in the Artificial Intelligence community, trying to innovate in the techniques used for combining the data and to refine state estimates and predictions. Intelligent systems can improve information fusion based on the context management aimed at supporting decision making, since the quality of decision making depends upon the quality of information at hand. A clear example is the multiagent systems in distributed sensor networks or the intelligent agents used for context-awareness that can provide both distributed fusion and advanced reasoning capabilities. Multiagent systems can fuse data from different sensors in a given environment and incorporate intelligent methods capable of facilitating decision support systems.

This special issue presents recent information fusion solutions in distributed sensor networks, which employ intelligent algorithms to improve or adapt their performance in highly demanding conditions. It contains six papers, of which four cover representations and exploitations of high-level and contextual information in real systems, and two are related to multiagent interaction and coordination in distributed sensor networks.

Firstly, we start with the papers that use context information to improve the understanding of a real scenario. "*Intelligent analysis for georeferenced video using context-based random graphs*" by J. Feng et al., the authors propose a method of mapping georeferenced video sequences for geographical scenes, use contextual random graphs to investigate semantic knowledge of georeferenced video, leading to correlation analysis of the target motion elements in the georeferenced video stream. The data are obtained using a wireless network of environmental sensors scattered at the supervising area and a vision sensor monitoring the same geographical area. The new contribution of the presented approach is the complementary use of the context-based random graph grammar in georeferenced video, developing a scientific analysis of behavior and developing structured methods of georeferenced video understanding.

One of the most important issues of distributed sensor networks is its application to activity recognition. Distributed sensor networks provide computer systems with raw information about the situation taking place in the real world. In general, activity recognition analyzes what is this

information and predicts the actions, plans, and trajectories of the objects of interest in a particular scenario. Classical techniques—those strongly based on observational data and a priori knowledge models—have proved to be insufficient to successfully recognize situations in unpredictable and complex scenarios with noisy and incomplete sensor data. A solution to overcome these problems may be to provide activity recognition algorithms with additional knowledge not directly provided by the cameras; that is, context knowledge, opening the important challenges of context representation and exploitation. In this special issue, there are two papers covering this issue. One of them is "*A feature selection approach to the group behavior recognition issue using static context information*" by A. Pozo et al. In this paper, authors have developed and tested four systems that use some low-level features (like positioning) to recognize high-level features, namely, group behavior. This approach is applied to the 2-on-2 basketball domain, where there are few elements in the scene and, therefore, few features to analyze. Static context information is very important for defining the scene setting. For example, in the basketball domain, they know that there are two groups with two members. All this context information depends on the specific domain and would sometimes need to be described by an expert. On the other hand, "*Using activity recognition for building planning action models*" by J. Ortiz et al. applied intelligent algorithms to build a novelty system that builds an automated planning. This automated planning is generated after an activity recognition event has been done and a planning action model has been inferred. The goal of this paper is to build a system capable of guiding users while they are completing an activity. It describes the system ASRA-AMLA that automatically learns and generates user action models (represented as an STRIPS planning domain in PDDL) using the recognized actions and context information (states of the sensors) between the actions, in order to assist users while they cook a recipe (by providing them a sequence of actions to accomplish their goal). The originality of this work is that it focuses on user's actions (subtasks) composing an activity and the effect these actions have (learning of preconditions and effects of each action, from sensor readings).

"*Radar tracking system using contextual information on a neural network architecture in air combat maneuvering*," by A. Navidad et al. uses soft computing techniques for developing and adapting data fusion in air surveillance radar tracking systems. In this paper, authors feature the theoretical aspects of a tracking algorithm based on neural network paradigm where, from discrete measurements provided by surveillance radar, the objective will be to estimate the target state for tracking purposes as accurate as possible. The absence of an optimal statistical solution makes the featured neural network attractive despite the availability of complex and well-known filtering algorithms. Authors use the capabilities of letting the network learn, not only from the received radar measurement information, but also from the aircraft maneuvering context, contextual information, where tracking application is working, taking into account this new contextual information which could be obtained from predefined, commonly used and well-known aircraft trajectories.

Finally, this special issue finishes with two papers related to multiagent interaction and coordination in distributed sensor networks. "*Fusion of agent actions into reputational images with probabilistic planning*" by J. M. Moya et al. addresses the coordination process in multiagent systems as a probabilistic planning problem that offered a descriptive and complete solution under the data fusion discipline. Authors propose a deliberative architecture based on the concept of trust proposed by Castelfranchi and Falcone and, after this work, they have confirmed the possibility of integrating a deliberative reasoning guided by cognitive trust module in a seamless way, thanks to the flexibility which RDDL offers. This approach has been verified by the simulation results showed in this work. "*Personalization of the workplace through a proximity detection system using user profiles*" by C. Zato et al. presents a proximity detection prototype for future use in an integral system primarily oriented to facilitate the labor integration of people with disabilities. The most important thing is to detect the proximity of a person to a computer using ZigBee technology and to then personalize the workplace according to the user's profile. The paper presents a multiagent-based proximity detection prototype, specifically developed for a work environment, which can facilitate tasks such as activating and personalizing the work environment.

In conclusion, research on intelligent systems and context-based information fusion in distributed sensor networks has matured during the last decade and many effective applications of this technology are being deployed now. This special issue has collected a representative sample of the latest scientific developments and their effective applications, to assess the impact of the approach and to facilitate technology transfer. Special care has been given to highlight successful opportunities in the application of AI paradigms to open challenges in information fusion and practical approaches to solving real-world problems.

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