ABSTRACT
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Cooperative Context Aware Setup and Performance of Surveillance Missions Using Static and Mobile Wireless Sensor Networks

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Surveillance systems are usually employed to monitor wide areas in which their users are interested in detecting and/or observing events or phenomena of their interest. The use of wireless sensor networks in such systems is of particular interest as these networks can provide a relative low cost and robust solution to cover large areas. Emerging applications in this context are proposing the use of wireless sensor networks composed of both static and mobile sensor nodes. A motivation for this trend is to reduce deployment and operating costs, besides to provide enhanced functionalities. The usage of both static and mobile sensor nodes can reduce the overall system costs, by making low-cost simple static sensors cooperate with more expensive and powerful mobile ones. Mobile wireless sensor networks are also desired in some specific scenarios in which mobility of sensor nodes is required, or there is a specific restriction to the usage of static sensors, such as secrecy. Despite the motivation, systems that use different combinations of static and mobile sensor nodes are appearing and with them, challenges in their interoperation. This is specially the case for surveillance systems.

This work focuses on the proposal of solutions for wireless sensor networks including static and mobile sensor nodes specifically regarding cooperative and context aware mission setup and performance. Orthogonally to the setup and performance problems and related cooperative and context aware solutions, the goal of this work is to keep the communication costs as low as possible in the execution of the proposed solutions. This concern comes from the fact that communication increases energy consumption, which is a particular issue for energy constrained sensor nodes often used in wireless sensor networks especially if battery supplied. In the case of the mobile nodes, this energy constraint may not be valid, since their motion might need much more energy. For this type of nodes the problem in communicating is related to the links' instabilities and short time windows available to receive and transmit data. Thus it is better to communicate as little as possible. For the interaction among static and mobile sensor nodes, all these communication constraints have to be considered.

For the interaction among static sensor nodes, the problems of dissemination and allocation of sensing missions are studied and a solution that explores local information is proposed and evaluated. This solution uses mobile software agents that have capabilities to take autonomous decisions about the mission dissemination and allocation using local context information so that the mission's requirements can be fulfilled. For mobile wireless sensor networks, the problem studied is how to perform handover of missions among the nodes ac problem assumes that each mission has to be done in a given area of interest, and the nodes are assumed to move according to different movement patterns passing through these areas. It is also assumed that they have no commitment in staying or moving to a specific area due to the mission that they are carrying. To handle this problem, a mobile agent approach is proposed in which the agents implement the sensing missions' migration from node to node using geographical context information to decide about their migrations. For the networks combining static and mobile sensor nodes, the cooperation among them is approached by a biologically-inspired mechanism to deliver data from the static to the mobile nodes. The mechanism explores an analogy based on the behaviour of ants building and following trails to provide data delivery, inspired by the ant colony algorithm. It is used to request the displacement of mobile sensors to a given location according to the need of more sophisticated sensing equipment/devices that they can provide so that a mission can be accomplished.

The proposed solutions are flexible, being able to be applied to different application domains, and less complex than many existing approaches. The simplicity of the solutions neither demands great computational efforts nor large amounts of memory space for data storage. Obtained experimental results provide evidences of the scalability of these proposed solutions, for example by evaluating their cost in terms of communication, among other metrics of interest for each solution. These results are compared to those achieved by reference solutions (optimum and flooding-based), providing indications of the proposed solutions' efficiency. These results are rather close to the optimum one and significantly better than the ones achieved by flooding-based solutions.