Connectivity loss prevention in a mobile sensors network: Algorithm for maximizing area coverage and network survival time

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ABSTRACT

Recent advances in technologies for UAVs are now mature to investigate new capabilities for them. In the field of autonomous UAVs (not human operated), the main research topic is focused on the swarming behavior. Several UAVs share a mission and they have to collaborate to succeed. This collaboration have to be efficient both in term of communication link and in term of global movement. Meanwhile, for such system of UAVs, saving power is still an issue to obtain efficient system to accomplish their mission. A mandatory step before deploying mobility models on swarm of UAVs is to build efficient mobility models to ensure the feasibility of such an approach that guarantee to meet the expected performances in term of energy consumption and connectivity constraints.

One way to model UAVs flying as a swarm is to consider them as a network of mobile sensors with battery. Recent researches [1]–[4] are facing some problems such as defining mobility models, battery control, connectivity loss, obstacle detection and shunning, fault tolerance. The problem addressed in this paper is a combination of some of them. We introduce a new problem concerning sensors networks that belongs to both MANET and WSN. The network is composed by sensors, battery operated, that move and communicate in order to maximize both lifetime of the connected network and the recorded/sensed area.

From a detailed analysis of the current researches in these fields for both MANET and WSN, we build an hybrid decentralized method to solve the problem combining several approaches. First, the connectivity constraints for transmitting data is satisfied by building a backbone where all the UAVs are connected. The election of the UAV backbone members is performed in a decentralized way. In addition, as the communication range is constant, we used some forces (based on potential fields methods) to ensure that sensors are in the communication range of they neighbors. Finally, the energy consumption problem is managed by assigning various state to the sensors influencing the forces applied to each other in order to maintain the global structure without breaking the backbone.

In future works, we plan to present metrics evaluating the performance of the proposed solution. As the two objectives are antagonist, we also plan to compare our system to the optimum solution of each one. We will thus study the performances of our hybrid mobility model varying its parameters.

Keywords: MANET, WSN, Coverage, Connectivity, Energy management

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