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LOCAL PSO-BASED APPROACHES FOR COOPERATIVE UAVS WITH APPLICATIONS

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Abstract: Recently, unmanned aerial vehicles (UAVs) have been used in a number of different fields, especially in military and civilian fields like firefighting and rescue, as well as in specific fields like research and surveillance. Also, as UAVs' platforms get better, they are becoming a source of data for mapping, monitoring, and inspection applications. This will bring up the subject of coordination as well as the approach that was chosen, which is what led to the drive for concerted research efforts to build new cooperative decision-making and control algorithms. These algorithms solve the challenge of managing several UAVs so that they can work together to accomplish a number of different tasks.

Because of the increased use of these cooperative systems in unknown environments, it is essential that they be reliable in order to prevent any catastrophic event and, as a result, to ensure the acquisition of the information that is sought while simultaneously optimizing the amount of time that is spent carrying out the mission. So, the overall performance of the fleet of drones must be kept up, even though individual parts will inevitably break down or the network and environment will change. As a consequence of this, this thesis presents studies that center on the adoption of new approaches in the field of cooperative operations carried out by drones.

Our aims, which are detailed in the study that was described in this work, can be summed up in two aspects. The first aim provides an optimization technique for determining moving target locations in an unknown environment by deploying cooperative UAVs.

A strategy like this one seeks to increase the effectiveness of drone identification while also cutting down on the total amount of time and energy spent searching and the impact of the uncertainty created by target mobility. To be more specific, we report based on the drone scanning a location and taking into account I the limitations of detection and communication coverage and (ii) either a false alarm or inaccurate detection of the target, or the existence or absence of the target, depending on which of these categories the target falls under. In addition to this, based on a cooperative and competitive particle swarm optimization (PSO) algorithm, a decentralized target search model that is based on a real-time dynamic assembly of small sub-swarms of cooperative drones is presented. This model is referred to as LoPSO. Each individual sub-swarm's mission is to quickly confirm the target position, which is then refined using Bayesian theory. Each UAV utilizes this tactic by operating in one of two flying modes, either the swarm mode or the greedy mode, and by taking into account data received from other UAVs in order to increase the total amount of environmental information. The second goal is to investigate the use of several cooperating UAVs to search for sources of pollution in an area that is currently unknown. To be more specific, a method-based probabilistic search strategy known as LoPSO is presented in order to design an optimal strategy that enhances cooperative drone search while simultaneously shortening the total amount of time spent searching and increasing the effectiveness of source detection. The whole plan is broken down into two parts: the discovery phase and the exploitation phase.

The primary task for the first phase is plume detection and tracing, in which each drone works in either the Greedy or LoPSO mode and picks its route depending on the plane coordinates generated according to the mode. During the exploitation phase, the primary emphasis is placed on conducting a pinpoint search for the specific position of the polluting source. This is accomplished by exploiting regions that have a high chance of source finding while flying in LoPSO flight mode. This is done through the use of probabilistic computation, which makes use of the Bayesian process model to produce and update the probability map of the location of the pollutant source whenever fresh sensor data is made available.

Keywords: Cooperative unmanned aerial vehicles, local particle swarm optimization, particle swarm optimization, stochastic mathematical modeling,.

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