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COMBINED-TYPE QUADCOPTER ELECTRIC DRIVE CONTROL SYSTEM FOR EFFICIENT MULTI-AGENT SEARCH OPERATIONS

Olugola Samuel Chisom
Scientific supervisor – Zayarny Vladimir Petrovich

Distributed multi-robotic systems (MRS) or multi-agent systems (MAS) have found extensive applications in various fields such as search and rescue, environment monitoring, surveillance, and landmine detection. These systems offer advantages such as reduced mission time, robustness to individual robot failures, and lower cost. In particular, quadcopters equipped with downward-facing cameras have proven to be suitable for tasks like searching for survivors in disaster-stricken areas or detecting mines and enemy targets.

In this thesis, we propose a multi-agent search strategy using quadcopter UAVs as search agents and downward-facing cameras as sensors. We introduce a practical approach where the search effectiveness of the camera varies across its image frame, with maximum effectiveness at the center and gradual degradation towards the edges. We model the lack of information about the presence or absence of targets as an uncertainty density distribution, where uncertainty is represented by values of 1 or 0. Based on this uncertainty distribution and the decreasing search effectiveness model, we address the problem of optimally deploying quadcopters to maximize uncertainty reduction and information gain.

Inspired by the concept of centroidal Voronoi configuration, we formulate a deployment and search strategy. The quadcopters are deployed to a configuration that maximizes uncertainty reduction and then perform search operations. This process continues until the average uncertainty over the entire search space falls below a predetermined threshold, indicating successful target detection with a desired level of confidence.

We also focus on the spatial variation of the camera's effectiveness in target detection. By conducting experiments using AuRuco markers and triangular-shaped objects as targets, we obtain a sensor effectiveness model for downward-facing cameras in different scenarios. We establish that an exponential function with two parameters can effectively represent the spatial variation of the camera's search effectiveness.

To validate our proposed search strategy, we develop a simulation platform using ROS/Gazebo and Matlab. This platform allows us to conduct realistic simulation experiments and compare the performance of the strategy under different parameters such as camera search effectiveness, sensor range, and number of robots. We present detailed results of the experiments and simulations, highlighting the effectiveness of our approach.

The simulation platform can also be utilized for experiments using physical AR Drones, providing a bridge between simulation and real-world scenarios. By conducting a large number of simulation and physical experiments, it becomes possible to determine optimal parameters for specific search scenarios, including the number of quadcopters and the type of cameras to be used.

In conclusion, our proposed multi-agent search strategy, supported by the experimental setup and simulation platform, offers a practical approach for efficient and effective search operations. By bridging theory and experimentation, our work contributes to the advancement of multi-robotic systems in real-world applications.

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AUTOMATED WATER TREATMENT FACILITIES FOR FISHERY COMPLEX

Venus Evangalin Charles

Scientific supervisor – Zayarny Vladimir Petrovich

Water management in ponds is crucial for various purposes such as aquaculture, irrigation, and environmental conservation. However, manual water pumping and treatment processes can be laborintensive, time-consuming, and prone to errors.

The sensor network consists of input devices, controller, and output devices. This sensor network was used to sense pH, temperature, and turbidity of the water so as to ensure good water quality in order to achieve a healthy environment for the fishes. The block diagram in Figure 1.1 briefly shows these parts.

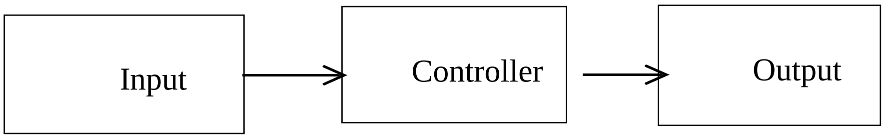

Figure 1.1: Block diagram of the Sensor Network