# "Distributed Multi-Robot Search and Rescue Operations Using Aggregative Optimization in a Multi-Room House Environment"

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This project aims to implement a Multi-Agent System (MAS) in Python to simulate a multi-robot team during a Search and Rescue (SAR) operation within a multi-room house. The system will employ an aggregative optimization algorithm to ensure that robots autonomously organize and execute tasks while meeting both local and global objectives. The robots, modeled as a graph, will compute their optimal trajectories using a gradient method algorithm to minimize their cost functions derived from local targets, global information such as walls and obstacles, and consensual data shared among neighbors. Each agent will solve a decoupled optimization problem with respect to its own position and target but will experience coupling in the cost function due to aggregative variables such as the formation's barycenter and the gradient of the cost with respect to the barycenter. These consensual decision variables will be learned by the agents through dynamic average consensus. Additionally, the agents' cost functions will be influenced by obstacle points, which will be avoided through potential functions associated with each obstacle. The environment will be two-dimensional (as well as the robots), with different rooms connected by passages and corridors. The number of agents, the order of the rooms, and other optimization parameters will be chosen by the user in advance and specified in yaml configuration files. Throughout the SAR operation, the robots will navigate from the house entrance to the exit, collaboratively solving tasks specified in advance by the user. Obstacles and global targets, such as protecting a person, will be treated as artifacts necessitating coordinated action among the robots. The entire system will be developed using an object-oriented programming (OOP) approach in Python, ensuring modularity and future integration into the ROS2 framework for real-world deployment. Animations and plots will be presented at the end of the trajectory computations to demonstrate the algorithm's effectiveness in accomplishing each task of the SAR process.