

Tugas IIi sistem pengaturan Formasi dan kolaborasi

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1. First paper, I choose paper with titled "A Control Lyapunov Function Approach to Multiagent Coordination" proposes a novel approach to multiagent coordination using Control Lyapunov Function (CLF) theory. The authors, P. Ogren, M. Egerstedt, and X. Hu, argue that the use of CLF theory allows for the coordination of a group of agents to achieve a desired collective behavior while respecting certain constraints. The paper proposes a novel approach to multiagent coordination using Control Lyapunov Function (CLF) theory. The authors argue that the use of CLF theory allows for the coordination of a group of agents to achieve a desired collective behavior while respecting certain constraints.

The authors first discuss the challenges of multiagent coordination, including communication constraints, uncertainty, and decentralized control. They then introduce the concept of CLF, which is a function that provides a measure of the stability of a control system. The authors argue that CLFs can be used to design control laws that ensure the stability of a group of agents while coordinating their behavior.

The authors then present a specific example of multiagent coordination, in which a group of agents are tasked with forming a desired formation. The authors use CLF theory to design a control law that ensures that each agent moves towards its desired position in the formation while avoiding collisions with other agents. The authors show through simulation results that their approach is effective in achieving the desired formation while ensuring stability and collision avoidance.

The authors also discuss the limitations of their approach, including the need for a priori knowledge of the system dynamics and the lack of scalability to large systems. They propose future research directions to address these limitations, including the use of adaptive control and distributed optimization techniques.

Overall, the paper presents a new approach to multiagent coordination using CLF theory, which allows for the coordination of a group of agents to achieve a desired collective behavior while respecting certain constraints. The authors' example of forming a desired formation demonstrates the effectiveness of their approach, and the use of simulation results provides evidence of its practicality. The paper could be valuable to researchers in the field of multiagent coordination who are looking for new approaches to solve the challenges posed by this problem. However, the limitations of the approach suggest that further research is necessary to fully explore its potential.

Second paper will discuss is the paper titled "Distributed Coordination Control of Multiagent Systems While Reserving Connectedness" proposes a distributed control approach to ensure that a group of agents maintains connectivity while coordinating their behavior. The authors, M. Ji and M. Egerstedt, argue that connectivity is crucial in multiagent systems, and their proposed approach ensures that the agents remain connected while achieving a desired collective behavior.

The authors first introduce the concept of connectivity preservation, which ensures that the group of agents remains connected during their motion. They then present the problem of multiagent coordination and the challenges it poses, including communication constraints, uncertainty, and decentralized control. The authors argue that their approach can address these challenges while ensuring connectivity preservation.

The authors then present their distributed control approach, which consists of two stages: the first stage ensures connectivity preservation, and the second stage achieves the desired collective behavior. In the first stage, each agent maintains a local control law that ensures connectivity preservation, while also exchanging information with its neighbors to update its control law. In the second stage, each agent uses a local control law to achieve the desired collective behavior, while also exchanging information with its neighbors to update its control law.

The authors show through simulation results that their approach is effective in achieving the desired collective behavior while ensuring connectivity preservation. They also show that their approach is robust to communication delays and failures and can handle changes in the group's topology. The simulation results demonstrate the effectiveness and robustness of the proposed approach in achieving the desired collective behavior while ensuring connectivity preservation. The authors also showed that their approach was robust to communication delays and failures and could handle changes in the group's topology.

Overall, the paper presents a distributed control approach to ensure connectivity preservation while coordinating the behavior of a group of agents. The author’s approach addresses the challenges of multiagent coordination, including communication constraints, uncertainty, and decentralized control. The simulation results provide evidence of the effectiveness and robustness of their approach. The paper could be valuable to researchers in the field of multiagent coordination who are looking for new approaches to ensure connectivity preservation while achieving a desired collective behavior. However, the paper's limitations suggest that further research is necessary to fully explore its potential. For example, the authors assume that the agents have access to the global network topology, which may not be practical in some applications.

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2. Now, to analyze the stability of the dynamics, we need to examine the behavior of the system around an equilibrium point. Let's assume that and are equilibrium positions of agents and , respectively.

At the equilibrium, we have:

To check the stability, let's consider small perturbations around the equilibrium positions, denoted by and :

Substituting these perturbed positions into the dynamics equation, we get:

Assuming the perturbations are small , the term can be approximated as where denotes higher-order terms of the perturbations. Since , the dynamics equation becomes:

As the terms cancel out, the stability analysis relies on the higher-order terms of the perturbations, Generally, this analysis can be challenging to perform analytically and might require linearization of the dynamics, such as using the Jacobian, to assess the stability properties.

If the desired interagent separations are feasible and the perturbations are small, it's possible that the system is locally stable, meaning that it converges to the equilibrium point for small perturbations. However, a more rigorous analysis is necessary to assess the stability properties of this nonlinear system definitively.

1. Feasible function that helps the agents minimize the deviation from the desired formation while avoiding obstacles. One approach is to use a combination of potential fields and formation cost functions:

The formation cost function can be defined based on the square and line formations:

where and are the costs associated with the square and line formations, respectively. These costs can be computed based on the deviation of the agents from the desired distances in each formation.

The obstacle cost function can be modeled using repulsive potential fields:

approximate the agents' movement from their initial positions to the final point (10, 10):

* + 1. Starting from their initial positions, the agents form a square formation.
    2. As they approach point (4, 5), they detect the red obstacles.
    3. Due to the obstacle cost function, the agents are repelled from the obstacles and switch to the line formation to navigate around them.
    4. Once they clear the obstacles, the agents revert to the square formation, as it is their preferred formation.
    5. The agents continue to move towards the final point (10, 10) in the square formation.

As the agents navigate through the environment, function dynamically balances the cost of maintaining the desired formations and avoiding obstacles. By adjusting the weights , and , you can control how strongly the agents prioritize formations or obstacle avoidance. The changing of the formation works based on the minimization of the overall energy function , with the agents switching between the square and line formations as necessary to navigate through the environment.

1. The Hungarian algorithm is a combinatorial optimization algorithm that is commonly used for graph labeling and agent assignment problems. The algorithm is used to find an optimal matching between two sets of objects, given a cost function that assigns a cost to each possible pair of objects. The algorithm was developed by two Hungarian mathematicians in the 1950s, and it has since been used in a wide range of applications.

One of the most common applications of the Hungarian algorithm is in the context of graph labeling. In this application, the algorithm is used to assign labels to the vertices of a graph, such that each label appears exactly once, and the total cost of the labeling is minimized. This problem is often referred to as the assignment problem, and it arises in many different contexts, such as scheduling, resource allocation, and transportation.

Another common application of the Hungarian algorithm is in the context of agent assignment. In this application, the algorithm is used to assign agents to tasks, such that each task is assigned to exactly one agent, and the total cost of the assignment is minimized. This problem arises in many different contexts, such as task allocation in robotics, job scheduling, and supply chain management.

Compared to other algorithms used for graph labeling and agent assignment, such as brute-force search and linear programming, the Hungarian algorithm is relatively fast and efficient. The algorithm has a worst-case time complexity of where n is the number of objects being matched, which makes it much faster than other algorithms in many practical scenarios. The algorithm is also very easy to implement and requires minimal memory, which makes it a popular choice for many applications.

However, the Hungarian algorithm has some limitations. For example, it assumes that the cost function is a metric, which means that it satisfies certain properties, such as symmetry and triangle inequality. This assumption may not always hold in practice, and in such cases, other algorithms may be more appropriate. Additionally, the Hungarian algorithm can only be used to solve matching problems where the number of objects in each set is equal. If the number of objects is not equal, then a modified version of the algorithm must be used, which can be less efficient.

In conclusion, the Hungarian algorithm is a powerful algorithm for solving graph labeling and agent assignment problems. It is fast, efficient, and easy to implement, which makes it a popular choice for many practical applications. However, it has some limitations, and its performance may depend on the specific problem being solved.

1. Switching formation quickly for formations that require robots to be physically far from each other is possible, but it can be more challenging with proximity-based interaction graphs. Some potential solutions to these challenges include:
2. Expanding communication range: By extending the communication range, robots can maintain connectivity while being physically farther apart. This can enable faster formation switching for formations requiring a larger distance between robots.
3. Global control: Using a centralized controller or a hierarchical control structure can help in coordinating the movement and communication between robots, making it easier to switch formations quickly.
4. Predefined transition paths: Designing predefined paths that robots follow during the transition between formations can help maintain communication connectivity and ensure efficient formation switching.
5. Flexible communication topologies: Introducing adaptive communication topologies that change based on the required formation can help maintain the necessary connectivity while allowing the robots to move to desired positions.

In summary, while the proximity graph assumption presents challenges for formation control, it is possible to switch formations quickly with the right techniques and strategies. By expanding communication ranges, adopting global or hierarchical control, and using predefined transition paths or flexible communication topologies, robots can effectively switch between formations, even if they are physically far from each other.