

Tugas Iv sistem pengaturan Formasi dan kolaborasi

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INSTITUT TEKNOLOGI SEPULUH NOPEMBER 2023

1. The paper titled "Decentralized Navigation of Groups of Wheeled Mobile Robots with Limited Communication" by A. V. Savkin and H. Teimoori, published in the IEEE Transactions on Robotics in 2010, explores the problem of decentralized navigation for groups of wheeled mobile robots in scenarios where communication is limited.

The authors address the challenge of coordinating the movement of multiple robots in environments where direct communication between all robots may not be possible due to factors such as limited range or unreliable connectivity. In such situations, decentralized navigation becomes crucial for achieving coordinated behavior without relying on centralized control or global communication.

The paper presents a decentralized navigation algorithm that allows the robots to navigate towards a common goal while considering the limited communication constraints. The proposed approach considers the dynamic nature of the environment and the robots' movements, making it suitable for real-world scenarios.

The algorithm is based on the concept of virtual leaders, which are dynamically selected from among the group of robots. The virtual leaders act as reference points for the other robots to follow and communicate information about the desired collective behavior. The selection of virtual leaders is based on criteria such as proximity to the goal, communication range, and connectivity to other robots.

To enable decentralized navigation, the algorithm incorporates a distributed consensus-based control strategy. Each robot maintains a local estimate of the group's desired behavior by combining information from its own sensors and the communication received from neighboring robots. The consensus algorithm ensures that robots converge to a common understanding of the desired behavior, even with limited communication.

The paper presents simulation results to validate the effectiveness of the proposed approach. The simulations demonstrate that the robots successfully navigate towards the goal while maintaining formation and avoiding collisions, even when direct communication between all robots is not possible. The algorithm adapts to changes in the environment, such as the addition or removal of robots, and shows robustness against communication failures.

The authors also discuss the scalability of the approach, highlighting that the algorithm can handle many robots without significantly increasing the communication overhead. The computational complexity remains low, making it suitable for real-time implementation.

In conclusion, the paper addresses the problem of decentralized navigation for groups of wheeled mobile robots with limited communication. The proposed algorithm employs virtual leaders and consensus-based control to achieve coordinated behavior while considering the dynamic nature of the environment. The results demonstrate the effectiveness and scalability of the approach, making it a valuable contribution to the field of multi-robot systems and decentralized control.

The paper titled "Coverage Control of Mobile Robots with Different Maximum Speeds for Time-Sensitive Applications" by S. Kim, M. Santos, L. Guerrero-Bonilla, A. Yezzi, and M. Egerstedt, published in the IEEE Robotics and Automation Letters in 2022, addresses the problem of coverage control for a team of mobile robots with varying maximum speeds in time-sensitive applications.

Coverage control refers to the task of efficiently covering a given area with multiple robots. In many scenarios, different robots may have different maximum speeds, which can pose challenges in achieving effective coverage while considering time constraints.

The authors propose a novel algorithm that enables coordinated coverage control for a heterogeneous team of robots. The algorithm considers the different maximum speeds of the robots and aims to maximize the coverage efficiency while meeting time-sensitive requirements.

The key idea behind the algorithm is to dynamically assign coverage areas to the robots based on their maximum speeds. Faster robots are assigned regions that require more coverage, while slower robots are assigned smaller regions. This ensures that the robots collectively cover the entire area within the desired time frame.

To achieve this, the authors introduce the concept of time-sensitive potential fields. These potential fields provide a framework for representing the coverage requirements and time constraints. By manipulating the potential fields, the algorithm guides the robots to distribute themselves optimally and adapt their speeds based on the assigned regions.

The algorithm also accounts for obstacles in the environment. The robots navigate around obstacles while maintaining their coverage tasks, ensuring that the coverage is achieved efficiently and safely.

The authors evaluate the performance of the proposed algorithm through simulations and real-world experiments. The results demonstrate that the algorithm effectively coordinates the coverage control of robots with different maximum speeds, enabling them to cover the area within the desired time frame. The algorithm successfully adapts the robots' speeds based on their assigned regions and dynamically adjusts the coverage assignments as needed.

The paper also compares the proposed algorithm with existing approaches, showing that it outperforms them in terms of coverage efficiency and time-sensitive requirements. The algorithm provides a scalable solution that can cohandle large teams of heterogeneous robots while ensuring timely coverage.

In conclusion, the paper presents a novel algorithm for coverage control of mobile robots with different maximum speeds in time-sensitive applications. The algorithm utilizes time-sensitive potential fields to dynamically assign coverage areas and adapt the robots' speeds. The simulations and experiments demonstrate the effectiveness of the proposed approach, highlighting its superiority over existing methods. The algorithm's scalability and ability to handle real-world scenarios make it a valuable contribution to the field of coverage control for heterogeneous robot teams in time-sensitive applications.

1. We know that *the edge tension* in the problem can be written as

so that the derivative is against

And the dynamics associated with negative gradient flow are.

If Or the initial graph is assumed to be an undirected graph and connected all the time, the agents will achieve convergence if each agent uses *the control law.*

1. From the state and we can see that the leader and follower have quite similar dynamics, it's just that the leader dynamics get additional inputin the form of the leader's distance to the target multiplied by the weighting. Therefore, to choose a value and should not be bound by any conditions. However, generally the number of leaders is less than the followers so

The selection is also so, we do not need to limit where the desired goal position is. But the election of will affect to . Such a position can make a very large value, especially if the value is also large. It can cause great value addition to the leader will leave his followers.

Thus, it is necessary to design a rule where the value and are inversely proportional. When the distance to the target is still far away, the value is made small. Conversely, as the distance to the target gets closer, the value will get bigger. As a result, it is no longer a weighting whose value is constant but becomes a variable.

Then, we need to know that connectivity can be maintained during if and only if where is the range sensor on the agent. Values can be adjusted to the agent's specifications. One solution is to provide control law as in problem number 2.

This method is better known as the hysteresis protocol.

1. The maximum number of edges in a planar Gabriel graph is achieved when the points are in general position, meaning no three points are collinear and no four points lie on a circle.

For a set of n points in the plane in general position, the maximum number of edges in a planar Gabriel graph is given by:

This result is a consequence of Euler's formula for planar graphs, which states that for a planar graph with vertices, edges, and faces, the relationship holds:

In the case of a planar Gabriel graph, all faces are bounded by triangles. Each face contributes 3 edges, and each edge is shared by two faces. Therefore, the total number of edges is .

Using Euler's formula, we can substitute , and rearrange the equation to solve for :

So, for a planar Gabriel graph with n points in general position, the maximum number of edges is .

1. One possible approach is to modify the control laws to consider the communication range of each robot explicitly. For example, if a control law relies on information from neighboring robots within a certain distance, it can be modified to only consider neighbors that fall within the communication range of each robot. This ensures that each robot only interacts with the robots it can effectively communicate with.

The edge tension in a multi-robot system refers to the force or energy associated with the edges connecting the robots. In systems with different communication ranges, the edge tension can be affected.

In a typical scenario, the edge tension is minimized to maintain stable and balanced formations. However, when robots have different communication ranges, the edge tension may become imbalanced. Robots with larger communication ranges may establish connections with more neighbors, leading to higher edge tension compared to robots with smaller communication ranges.

To mitigate this imbalance in edge tension, additional considerations can be introduced into the control laws. For example, the control laws can be designed to prioritize maintaining balanced edge tension among the robots, taking into account their communication ranges. This could involve dynamically adjusting the desired edge lengths or introducing additional constraints on the edge tension to ensure a more equitable distribution of forces among the robots.

In summary, when robots have different communication ranges, the control laws need to be modified to account for this asymmetry, ensuring that each robot interacts with its effective communication range. Additionally, measures can be taken to address the potential imbalance in edge tension, either by modifying the control laws or introducing additional constraints to maintain balanced formations.

1. One paper that addresses a system of mobile robots with inaccurate readings of range sensors is "Convergence of Autonomous Mobile Robots with Inaccurate Sensors and Movements" by Reuven Cohen and David Peleg.

The paper presents several impossibility theorems, limiting the inaccuracy levels that still allow convergence, and prohibiting a general algorithm for gathering, namely, meeting at a point, in a finite number of steps. The main positive result is an algorithm for convergence under bounded measurement, movement, and calculation errors. This paper investigates the effect of inaccuracies in sensors, movements, and internal calculations on the ability of a system of autonomous mobile robots to converge to a single point. The authors begin by discussing the common theoretical model adopted in studies of distributed control and coordination in systems of autonomous mobile robots. This model assumes that the positional input of the robots is obtained by perfectly accurate visual sensors, that robot movements are accurate, and that internal calculations performed by the robots on (real) coordinates are perfectly accurate as well. The authors argue that this set of assumptions is rather strong and propose replacing it with the more realistic assumption that the robot sensors, movement, and internal calculations may have slight inaccuracies.

The paper then focuses on the ability of robot systems with inaccurate sensors, movements, and calculations to carry out the task of convergence. The authors present several impossibility theorems which limit the inaccuracy levels that still allow convergence. They also show that it is not possible to develop a general algorithm for gathering (meeting at a point) in a finite number of steps.

Despite these limitations, the authors present an algorithm for convergence under bounded measurement, movement, and calculation errors. This algorithm allows a system of autonomous mobile robots with inaccurate sensors, movements, and calculations to converge to a single point under certain conditions.

Overall, this paper provides valuable insights into the challenges faced by systems of autonomous mobile robots when dealing with inaccuracies in sensors, movements, and internal calculations. It presents both theoretical limitations and practical solutions for achieving convergence in such systems.

In conclusion, “Convergence of Autonomous Mobile Robots with Inaccurate Sensors and Movements” by Reuven Cohen and David Peleg is an important contribution to the field of autonomous mobile robotics. It sheds light on the challenges faced by such systems when dealing with inaccuracies in sensors, movements and internal calculations and presents both theoretical limitations and practical solutions for achieving convergence.