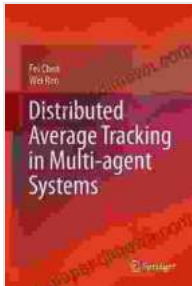


# Distributed Average Tracking In Multi Agent Systems: The Ultimate Guide



## Distributed Average Tracking in Multi-agent Systems

by Sophie Hardcastle

★★★★☆ 4.3 out of 5

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Distributed average tracking is a fundamental problem in multi agent systems, where a group of agents aims to collectively track the average of a set of values over time. This problem arises in various applications, including swarm robotics, cooperative control, and sensor networks. In this article, we provide a comprehensive overview of distributed average tracking in multi agent systems, covering fundamental concepts, algorithms, and future research directions.

### Problem Formulation

Consider a network of  $N$  agents, where each agent  $i$  has access to a local measurement  $x_i(t)$  of a global variable  $x(t)$ . The goal of distributed average tracking is for each agent  $i$  to estimate the average  $\bar{x}(t) = \frac{1}{N} \sum_{j=1}^N x_j(t)$  of the global variable  $x(t)$  over time, using only local interactions with its neighbors.

## Consensus Algorithms

Distributed average tracking algorithms are typically based on consensus algorithms, which are iterative procedures that allow a group of agents to reach an agreement on a common value. In the context of average tracking, the consensus value is the estimated average  $\bar{x}(t)$ .

There are several different consensus algorithms that can be used for distributed average tracking. Some common algorithms include:

- **Average consensus:** Each agent updates its estimate by averaging its current estimate with the estimates of its neighbors.
- **Weighted average consensus:** Each agent updates its estimate by weighting the estimates of its neighbors based on their reliability or importance.
- **Diffusion consensus:** Each agent broadcasts its estimate to its neighbors, which then update their estimates based on the received values.

## Applications

Distributed average tracking has various applications in multi agent systems, including:

- **Swarm robotics:** A swarm of robots can use distributed average tracking to estimate the average position of a target object.
- **Cooperative control:** A group of vehicles can use distributed average tracking to maintain a desired formation while traveling.

- **Sensor networks:** A network of sensors can use distributed average tracking to estimate the average temperature or air quality in an area.

## Future Research Directions

Despite significant progress in the field of distributed average tracking, there are still several open research challenges and future research directions, including:

- **Convergence analysis:** Developing more accurate and efficient convergence analysis techniques for distributed average tracking algorithms.
- **Robustness:** Improving the robustness of distributed average tracking algorithms to noise, communication delays, and agent failures.
- **Distributed optimization:** Exploring the use of distributed average tracking algorithms for solving distributed optimization problems.

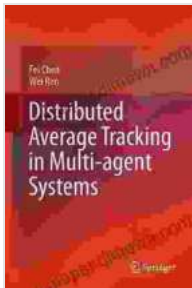
Distributed average tracking is a fundamental problem in multi agent systems with a wide range of applications. In this article, we have provided a comprehensive overview of the problem formulation, consensus algorithms, applications, and future research directions in this field. We believe that continued research in distributed average tracking will lead to the development of more efficient, robust, and scalable algorithms for a variety of real-world applications.

## References

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