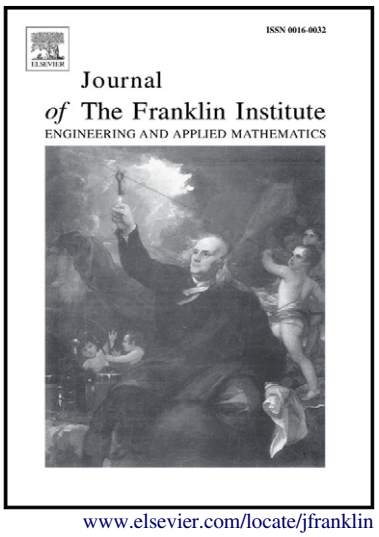


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# Leader-Following Discrete Consensus Control of Multi-Agent Systems with Fixed and Switching Topologies

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**Abstract**

In this paper a leader-following discrete type multi-agent consensus control problem with both switching and fixed interaction topologies have been discussed. Multi-agent system subjected to external disturbances is considered and dynamic output feedback based consensus controller was designed to ensure that the $H_\infty$ performance was achieved. A Powerful LMI algorithm is used to analyze consensus of multi-agent system. Besides, the feedback gain matrix is obtained through two LMIs, that guarantee the existence of common matrices satisfying consensus of multi-agent systems under dynamically interaction topology. Finally, a simulation example is presented to demonstrate the robustness of the proposed method.

**Keywords:** Multi-agent system; Consensus control, Dynamic output feedback; Discrete control; Robust $H_\infty$ control

## I. Introduction

In the past two decades, scientists across diverse fields have been trying to identify the underlying mechanisms of networked systems. Biologists use networks to study the working and wiring of transcriptional regulatory circuits. Sociologists use networks to predict the behavior of techno-social systems. Physicists use networks to model and predict the emergence of behavior norms, and use quantitative methods to analyze the resulting networked systems. A new feature of modern control theory engineering is to study the assembling and coordination of individual physical devices into a coherent whole in order to perform a universal task. This gives rise to a very active and exciting research field–*multi-agent systems*. Due to various practical applications of multi-agent system, like, delivery of smarter grid services in electric power systems[13], a tool to tackle health care problems in the field of organ transplants[14] and restricted use of antibiotics[15], it has received a noticeable treatment in many scientific domains.

An interesting research topic in the controls society with regards to multi-agent system is formation control, where a certain geometric pattern is formed with/without a group reference. The group reference, termed a leader or a virtual leader, represents the goal for the whole group. Leader is a special agent whose motion is independent of all the other agents and thus is followed by all the other ones. Although leaderless coordination is useful in many applications such as cooperative rendezvous of a group of agents, there are many applications that require a dynamic leader. In [19], [20] it has been demonstrated that leader-following arrangement is an energy saving technique and it can also improves the communication and coordination of the flock. In recent days, controllability and stability analysis in distributed multi-agent coordination has emerged as an interesting research topic. A multi-agent system is controllable if each agent in the system can be steered to a certain position by controlling one agent in the system, which is also called the leader.The main control techniques and approaches used in the stability analysis include adaptive control, pinning control, dissipativity theory, non smooth analysis, and Lyapunov functions.

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