Researchers at the University of South Florida have developed a distributed control approach for heterogeneous linear time-invariant multiagent systems with unknown leader dynamics over fixed and directed communication graph topologies.

Multiagent systems are composed of a large number of interacting agents, and they offer an innovative method of controlling large-scale, dynamic, heterogeneous physical systems. In such systems, the word “heterogeneous” means the dynamics of nodes or agents is different from one another. A typical complex environment like a manufacturing system consists of many sub-systems (people, equipment, etc.) and is influenced by turbulent surroundings and a high number of system states. The multiagent approach to controlling such a system offers modularity and distributes the control system. As such, these systems offer a promising way to reduce complexity and increase flexibility of a system. There is a need for more resilient control systems that can handle complex heterogeneous multiagent systems as demonstrated in this example.

Our researchers have invented a novel control system that utilizes a distributed approach to allow a group of heterogenous dynamic systems (e.g., aerial and ground vehicle teams) working in coherence, which have non identical dynamics and dimension. The approach uses a fundamental converse theorem for linear time-invariant systems to link input-output stability and internal stability. Agent-wise local sufficient conditions are derived to solve the problem of distributed output regulation. The approach paves the way for distributed controller design which is independent of the leader dynamics. This system could be implemented in a multitude of complex control systems where distributed stability criterion is desired.