

INFORMATION FLOW IN COOPERATIVE CONTROL OF MULTI-VEHICLE SYSTEMS

Richard Murray Alex Fax
Control and Dynamical Systems
California Institute of Technology
Pasadena, CA 91125

1 Objectives

This project is focused on developing the underlying theory required to achieve integration of information flow into control analysis and design for cooperative tasks of multi-vehicle systems. By making use of tools from control theory, dynamical systems, and graph theory, we are developing a framework for analyzing the effects of information and sensor topology on feedback systems and developing tools for designing information flow and control algorithms that build on this framework. We are applying these ideas to several test problems involving real-time, distributed control of a set of multiple vehicles performing cooperative tasks. In addition to computational exploration through simulation, we plan to implement our algorithms on a multi-vehicle, wireless testbed for networked control, communications, and computing that is being developed at Caltech.

2 Status of Effort

This is a new start (June 2001). We have performed initial work in examining the effect of network topology on stability of interconnected systems through application of graph theoretic techniques.

3 Accomplishments

Our initial work has focused on the problem of stability of a set of interconnected, identical linear systems. The interconnection structure is specified by a directed graph that indicates which nodes (agents) send information to other nodes. By examining the algebraic properties of the graph, we are deriving conditions for stability of the interconnected system that indicate the role that the topology of the graph (eg, number of cycles of given lengths). This work is still very preliminary, but we expect to report initial results at the time of the Contractors' Meeting.

4 Personnel Supported

Faculty

Richard Murray, Caltech

Graduate students

Alex Fax, Caltech

Lars Cremean, Caltech

5 Publications

None to date.

6 Interactions and Transitions

Meetings and conferences

Alex Fax presented preliminary results of this work at the Southern California Nonlinear Control Workshop on 1–2 June 2001 at the University of California, San Diego.

Consulting and advisory functions

None to date.

Transitions

None to date.

New Discoveries, Inventions, or Patent Disclosures

None to date.