Research proposal

Characterization of Observability and Controllability in Antagonistic Networks

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Start: from February 2014. Duration: 6 months. Location: Grenoble, France

Context. NeCS is a joint CNRS (GIPSA-lab)-INRIA team. The team is bi-located at INRIA (Montbonnot) and at the GIPSA-lab (at the Grenoble campus). The team addresses control problems raised by the consideration of distributed communication, sensing and actuation in networks systems.

Topic description. There has been significant recent interest in studying dynamical processes on large networks consisting of many interacting subsystems. One important research focus is to quantify how combinatorial network properties interact with continuous properties associated with the dynamics. Very recently, dynamics on networks with interactions that can be both positive and negative have been considered. Such networks provide an intriguing contrast with well-studied consensus and synchronization problems; in consensus networks, where weights are typically non-negative, states synchronize to a common value, whereas in antagonistic networks, the presence of both positive and negative weights can cause clusters to emerge that each synchronize to different values. Several interesting mathematical models for real networks feature both positive and negative interactions: in social networks, individual relationships can be friendly or hostile, giving rise to factions and, e.g., clustering in opinion dynamics; in genetic regulatory networks, genes can promote or repress the expression of other genes; in neuronal networks, neurons can excite or inhibit the firing of other neurons.

The purpose of this work is to provide a graph-theoretic characterization of observability/controllability for antagonistic networks. Up to now, such a characterization exists only for fully cooperative networks. For this purpose, in contrast to zero/nonzero patterns used for structural controllability, we will consider the sign pattern for a full characterization of observability.

References.


