

OBSERVABILITY STUDY IN WEIGHTED AND DIRECTED SIGNED MULTI-AGENT NETWORKS OF SINGLE- AND DOUBLE-INTEGRATOR DYNAMICAL AGENTS

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In this study we examine observability in signed multi-agent networks with a directed, weighted, and time-invariant communication topology. The network follows linear heterogeneous dynamics, incorporating both first- and second-order integrator agents in continuous time. Agents are classified into sensors (whose state information is fully known beforehand) and non-sensors (whose state information is completely unknown). The objective is to determine whether it is possible to reconstruct the states of non-sensors using the knowledge of the sensors, a property referred to as the network's sensor–non-sensor observability. We formulate the necessary and sufficient mathematical conditions for analyzing this property by utilizing the rank and spectral characteristics of the matrices governing the dynamics. These conditions are applied to various networks to assess their observability, demonstrating the effectiveness of the results presented. Our findings indicate that the sensor–non-sensor observability property in signed, directed, and weighted networks generally differs from that of their unsigned, undirected, and unweighted counterparts.

1. Introduction

Multi-agent networks (MAN) consist of multiple interacting agents, each capable of making certain decisions, processing

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