Systems and Control Seminar
Hatanaka Laboratory
Tokyo Institute of Technology

Minimal Information for Real-time Estimation and Control: A Semidefinite Programming Approach

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Abstract

Information is not free -- there are various situations where acquiring necessary information for real-time decision making is a costly process. In this talk, we discuss a methodology to design an ``information-efficient" sensor, whose information acquisition rate is minimal while allowing decision makers to make real-time decisions with acceptable accuracy.

Specifically, we formulate a problem of designing an information-efficient sensor for real-time estimation in the linear-quadratic-Gaussian (LQG) setting. Introducing a novel variable elimination technique, we show that the desired sensing policy can be efficiently found by semidefinite programming (SDP). Since it can be shown that our problem formulation is equivalent to the Gaussian sequential rate-distortion (SRD) problem, which is a natural generalization of the standard rate-distortion problem to multistage settings, our methodology also provides an efficient numerical algorithm to the existing SRD literature. To demonstrate practicality of this result, we consider a numerical case study of real-time satellite attitude estimation using minimal telecommunication. We also discuss an SDP-based solution to the information-regularized LQG control problems. Open problems and future perspectives of this research line will be also discussed.