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DISTRIBUTED OUTPUT CONSENSUS VIA LMI-BASED MODEL PREDICTIVE CONTROL AND DUAL DECOMPOSITION

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Abstract. *This paper proposes a distributed model predictive control method for solving an optimal consensus problem, where a system consists of networked multiple agents and the outputs of all agents converge to a common point. The problem is formulated as a convex optimization problem involving linear matrix inequalities, and then solved by using dual decomposition. In the proposed scheme, the state feedback matrix for each agent is computed at each time in a decentralized manner. It is proven that the outputs of all agents asymptotically converge using the proposed method if the optimization problem is feasible at the initial time. Numerical examples are presented to demonstrate the effectiveness of the proposed method.*
Keywords: Distributed control, Consensus, Model predictive control, Dual decomposition, LMI

1. **Introduction.** Research on control, estimation, and consensus under distributed and networked computing environments has received significant attention in recent years [1, 2, 3]. The common concept of such research is that an overall system achieves a goal while multiple agents interact with one another.

Consensus problems deal with the design of decentralized strategies such that the states or outputs of a group of agents asymptotically converge to a common value, a *consensus point*. This problem is relevant in many fields such as unmanned air vehicles, sensor networks and computer graphics (see [2] and the references therein). Recently, model predictive control (MPC) schemes have been applied to the consensus problem, and their effectiveness has been demonstrated in [4, 5]. Limitations exist in these schemes, and however, as a model to be considered is limited to a single- or double-integrator model [4], and a strong feasibility assumption is made [5, 6], which contributes to the proof of the convergence of the algorithm.

To cope with such limitations, MPC based on linear matrix inequality (LMI) techniques [7] was applied to the consensus problem in [8]. This MPC scheme can deal with more general dynamics, including a single/double integrator, and guarantee asymptotic convergence without any strong feasibility assumption. It is of note that, however, [8] focused on state consensus and is unable to handle a more general case, i.e., output consensus. Moreover, because the above MPC scheme [8] is based on a primal decomposition technique (see, e.g., [9]), the topology of communication between agents must be a cycle graph, and information regarding optimization is transferred to neighboring agents in a cyclic manner. Thus, a great deal of communication time is often required to perform the primal decomposition algorithm.