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GENERAL H_∞ CONTROL FOR HADAMARD SYNERGIC CONTROL: A COMPOSITE CONTROL STRATEGY VIA CONNECTION-REGULATION AND FEEDBACK CONTROL

Xinjin Liu and Yun Zou

School of Automation
Nanjing University of Science and Technology
No. 200, Xiaolingwei, Nanjing 210094, P. R. China
liuxinjin2006@163.com; zouyun@vip.163.com

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Abstract. *In this paper, H_∞ control problem is discussed for a recently proposed control strategy called the Hadamard synergic control that is achieved via a composite strategy of the state feedback control and the direct regulation of the part of connection coefficients of system state variables. Necessary and sufficient conditions for the existence of such H_∞ controllers are parameterized in terms of Bilinear Matrix Inequalities (BMIs). Moreover, some Linear Matrix Inequalities (LMIs) sufficient conditions are also obtained for the problem.*

Keywords: Hadamard synergic control, Hadamard matrix product, H_∞ control, Connection-regulation, Matrix inequalities

1. **Introduction.** The robust control theory involves two domains mainly: parameter uncertainty theory and H_∞ control theory. H_∞ control theory was well developed in the late 1980's. It involves with state space formulations [1] and comprehensive comparisons with the widely-known H_2 control problem [2]. In the early times, two Riccati equations and a spectral radius condition were given for the existence conditions for an H_∞ controller, and the stabilizing solutions to the Riccati equations with free parameter Q were used to parameterize the set of all H_∞ controllers. However, the free parameter Q is hard to choose for the controller design [3]. In the mixed H_2/H_∞ control problem, this control problem has been solved via highly nonlinear coupled matrix equations without the free parameter Q in [4, 5]. However, such matrix equations are very difficult to solve. [6] overcomes this difficulty using the finite dimensional convex method and obtains a feasible controller, then the necessary and sufficient conditions for the existence of an H_∞ controllers of any order are given in terms of three LMIs and a finite dimensional design space is proposed to substitute the infinite dimensional space, which does not require any assumptions on the plant and the set of all feasible controllers is parameterized explicitly of any order [7].

Consider the following linear time-invariant generalized system:

$$\Sigma_1 \begin{cases} \dot{x} = Ax + D_1\omega + B_1u \\ z = C_1x + D_2\omega + B_2u \\ y = C_2x + D_3\omega + B_3u \end{cases} \tag{1}$$

where $x \in R^{n_1}$ is the system state; $\omega \in R^{n_2}$ is any exogenous disturbances input; $u \in R^{n_3}$ is the control input; $z \in R^{n_4}$ is the regulated output; $y \in R^{n_5}$ is the measured output.

Most H_∞ control theory imposes the assumptions of $B_2^TB_2 > 0$, $D_3D_3^T > 0$. The conditions of exceptions of this assumption have been researched in [8]. [7] further develops