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NUMERICAL COMPUTATION FOR H_2 STATE FEEDBACK CONTROL OF LARGE-SCALE SYSTEMS

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Abstract. In this paper, we have studied the H_2 state feedback control for large-scale systems, focusing on the design of an optimal H_2 controller that is based on numerical algorithms. A new iterative algorithm is derived by combining the Kleinman algorithm with the fixed point algorithm. As a result, the H_2 controller can be constructed in the same dimension of the subsystems. It is proved that the proposed algorithm has a quadratic convergence as compared with the recursive algorithm. Moreover, it is shown that the resulting controller achieves $O(\varepsilon^{2^{k+1}})$ approximation of the optimal H_2 cost.
AMS (MOS) subject classification: 34K28, 49N05, 93C73

1 Introduction

For large-scale systems, the stability analysis and control and filtering problems have been investigated extensively (see e.g., [1, 2, 3]). In practice, these control problems are illustrated by the multiarea power systems [3]. In order to obtain the optimal solution, we must solve the Algebraic Riccati Equation (ARE) that is parameterized by the small positive coupling parameter ε. Various reliable approaches for solving the ARE have been well documented in many literatures (see e.g., [4, 15]). These methods consist of the invariant subspace approach, which is based on the Hamiltonian matrix [4], and the general matrix pencil technique, which is based on the extended Hamiltonian pencil [15] (in particular, the reference [15] is the most comprehensive study to date dealing with ARE by means of the matrix pencils). If the coupling parameter ε is sufficiently large, these approaches are very useful. However, when these methods are used, the dimension of the computing workspace should be twice that of the ARE. Furthermore, there is no guarantee of symmetry of the ARE solution when the ARE is known to be ill-conditioned [4]. Therefore, the numerical computation must be reduced and a new numerical algorithm is required for obtaining the exact symmetric solution since large-scale systems include numerous subsystems.

A popular approach to deal with large-scale systems is the hierarchical technique (see e.g., [3]). In particular, in [3], the near-optimal controller was proposed. More recently, the H_2 state feedback control problem for