Optimal pair-layer stabilizer design

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Abstract

The purpose of this paper is to address the design of decoupled-level large system controllers using an optimal reduced order model whose state variables are all output states. The reduced-order model retains their physical meaning and is used to design a decoupled-level linear feedback controller that takes into account the realities and constraints of the large systems. The decoupled-level control strategy is used and a global control signal is generated from the output variables to minimize the effect of interactions. As a result, the effectiveness of this controller is evaluated and considerable savings in computer memory are achieved. In conclusion, the controllers determined at the subsystem level depend only on local information operating to the particular machine. Example is given to illustrate the advantages of

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the proposed method. Responses of the system with decoupled-level scheme and optimal reduced order scheme are included for comparative analyses. It is recommended that the proposed method can be applied to supper large system.

1. Introduction

The design of large system can be formulated as an optimal linear regulator control problem whose solution is a complete state control scheme [1]. Thus, the implementation requires the design of state estimators [2]. These increase the hardware cost and reduce the reliability of the control system. These are the reasons that a control scheme uses only some desired state variables such as output states. Upon this, a scheme referred to as suboptimal control is obtained but only some state variables are used in the implemented control scheme while the others are omitted for convenience [3].

Obviously, this approach is arbitrary and cannot be accepted on faith. Performance degradation is not evaluated for general system sunder different conditions. The recent approach using optimal reduced order model is obtained [4] [5].However, the optimal control strategy is also used for the reduced order model of the large system, the computation of an optimal controller becomes extremely difficult and time consuming as the order of the system increases. For an nth-order system it is necessary to solve an n(n+1)/2 Riccati equations in order to calculate the controller gain. And the problem formulation itself is not straight forward as it is complex to determine the design parameters in the performance criterion as the order of the system increases. To overcome these difficulties, the former paper concerned with the development of multi-level optimal stabilization of interconnected power system in ref. [6] is applied to the proposed approach. The overall system is decomposed into separate subsystems, each subsystem comprising one machine. At the subsystem level, an optimal feedback controller is derived by output feedback of each machine. The order of this model is obviously lower than that of the overall system and the method proposed in ref [6].Consequently, considerable savings in computer memory are achieved. The controllers thus determined at the subsystem level depend only on local information operating to the particular machine. And, since only the output feedback is used via optimal reduced order model, the control strategy can be implemented easily.

In order to take into account the interaction between the different subsystems, a global controller is designed at a higher level [7]. At this level, all subsystems will transfer the necessary information to achieve