REDUCED ORDER OUTPUT FEEDBACK CONTROL DESIGN FOR PDE SYSTEMS USING PROPER ORTHOGONAL DECOMPOSITION AND NONLINEAR SEMIDEFINITE PROGRAMMING

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Abstract. The design of an optimal (output feedback) reduced order control (ROC) law for a dynamic control system is an important example of a difficult and in general nonconvex (nonlinear) optimal control problem. In this paper we present a novel numerical strategy to the solution of the ROC design problem if the control system is described by partial differential equations (PDE). The discretization of the ROC problem with PDE constraints leads to a large scale (nonconvex) nonlinear semidefinite program (NSDP). For reducing the size of the high dimensional control system, first, we apply a proper orthogonal decomposition (POD) method to the discretized PDE. The POD approach leads to a low dimensional model of the control system. Thereafter, we solve the corresponding small-sized NSDP by a fully iterative interior point constraint trust region (IPCTR) algorithm. IPCTR is designed to take advantage of the special structure of the NSDP. Finally, the solution is a ROC for the low dimensional approximation of the control system. In our numerical examples we demonstrate that the reduced order controller computed from the small scaled problem can be used to control the large scale approximation of the PDE system.

Key Words. proper orthogonal decomposition; interior point trust region method; nonlinear semidefinite program; reduced order output feedback; optimal control; partial differential equation.

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