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OPTIMAL CONTROLLER FOR THIRD DEGREE POLYNOMIAL SYSTEM

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Abstract. This paper presents the solution to the optimal controller problem for a stochastic system given by a polynomial equation of third degree, linear observations confused with white Gaussian noises, and a quadratic cost function. The obtained controller equations are applied to solution of the state controlling problem for a nonlinear automotive system. Simulation results are compared for the optimal polynomial controller given in this paper and the best linear controller available for the linearized system.
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1 Introduction

Although the optimal controller problem for linear system states was solved in 1960s, based on the solutions to the optimal filtering [3] and regulator [4, 2] problems, solution to the optimal controller problem for nonlinear (in particular, polynomial) systems has been impossible due to the absence of the solution to the corresponding filtering and control problems for nonlinear systems. This paper presents solution to the optimal controller problem for unobservable third degree polynomial system states over linear observations and quadratic criterion. Due to the separation principle for polynomial systems with linear observations and quadratic criterion, which is stated and substantiated in the paper analogously to that for linear ones (see [4]), the original controller problem is split into the optimal filtering problem for third degree polynomial system states over linear observations and the optimal control (regulator) problem for observable third degree polynomial system states with quadratic criterion. (Both the problems have been stated and solved in [1]).

The relatively simple case of third degree polynomial systems considered in this paper seems to be important for practical applications, since a nonlinear state equation can usually be well approximated by a polynomial of degree 3, the observations are frequently direct, that is linear, and the cost function in the controlling problems, where the desired value of the controlled variable should be maintained or maximized using the minimum control energy,