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COMPUTATION OF SUB-OPTIMAL FEEDBACK CONTROL FOR TIME –DELAYED OPTIMAL CONTROL PROBLEMS

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Abstract. In this paper, we use an interactive multivariate interpolation method proposed in [5] in conjuction with a cardinal product spline approach to compute a suboptimal feedback controller for a class of nonlinear optimal control problems with discrete time–delayed argument. Two examples have been solved to illustrate both the efficiency and the short–coming of the method.**AMS (MOS) subject classification:** 49N35

1. Introduction

Due to many efficient schemes in the literature for solving optimal control problems, it is possible to efficiently compute open–loop optimal controls for optimal control problems with very general nonlinear dynamics. However, it is well known that open–loop optimal controllers are very sensitive to disturbances, and thus feedback controllers are much more desirable in practice because of their robustness properties. For example, consider the task of launching a satellite into orbit. Suppose that the open–loop control is computed and supplied to the system. If during the launching period or at some time during the flight, the satellite is disturbed from the optimal path, then the satellite will more than likely continue on an incorrect path. However, if a feedback controller is used, the satellite will correct back to the optimal path after being disturbed. Due to a lack of computational power in the past, not much attention has been given to the computation of feedback controllers for such general problems until recently.

Although the solution of the Hamilton–Jacobi–Bellman(HJB) equation provides an optimal feedback control law ([1], [13]), the equation is very difficult to solve numerically. In [2], the perturbation feedback control method is discussed. This method forces the system to track a previously computed open–loop optimal trajectory by adding robustness and error tolerance properties into the system. However, the control effort spent in forcing the system to return to the optimal trajectory may not be economical. Using neural networks in synthesizing feedback control laws for general nonlinear dynamical systems has recently been investigated by [3], [8]. However, deciding on the number of layers and elements in the network can be time consuming. Moreover, stability results are extremely difficult to establish and hence one does not know how accurate the networks have performed.