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LINEAR QUADRATIC OPTIMAL CONTROL PROBLEMS WITH INEQUALITY CONSTRAINTS VIA RATIONALIZED HAAR FUNCTIONS

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Abstract. A numerical method for solving linear quadratic optimal control problems with inequality constraints is presented in this paper. The method is based upon rationalized Haar function approximations. The properties of rationalized Haar functions are first presented. The operational matrix of integration is then utilized to reduce the optimal control problems to the solution of algebraic equations. The inequality constrains are converted to a system of algebraic equalities, these equalities are then collocated at newton-cotes nodes. Illustrative examples are included to demonstrate the validity and applicability of the technique

Keywords. Rationalized Haar, Inequality constraints, Optimal control, Quadratic
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1 INTRODUCTION

The design of optimal feedback for linear systems was obtained by Kleinman [11]. Similar problems for linear systems have been studied either by means of the Walsh functions [3] or by means of the block-pulse functions [8]. Due to the nature of these functions, the solutions obtained were piecewise constant. Most of the computing techniques for the solution of optimal control problems successfully solve the unconstrained problem, but the presence of inequality constraints often resulted in both analytical and computational difficulties. Theoretical aspects of trajectories inequality constraints have been studied in [4,14]. Mehra and Davis [14] showed that difficulties arising from handling trajectories inequality constraints are due to the exclusive use of control variables as independent variables and presented the so-called generalized gradient technique.
Orthogonal functions, often used to represent arbitrary time functions, have received considerable attention in dealing with various problems of dynamic systems. The main characteristic of this technique is that it reduces these