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NUMERICAL METHOD FOR SOLVING CONSTRAINED NON-LINEAR OPTIMAL CONTROL USING THE BLOCK PULSE FUNCTIONS (BPFS)

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Abstract. *In this paper, the block pulse functions (BPFs) are used to solve linear and non-linear optimal control problems subject to terminal state constraints and saturation constraints on control. Based on BPFs, the optimal control problem is transformed to a non-linear programming problem. The resulting non-linear programming problem is solved using SNOPT which is interfaced through MATLAB via an optimization tool called TOMLAB. Concrete examples are studied where the simulation results show the efficiency of this method.*

Keywords: Optimal control, Block pulse functions, Non-linear system

1. **Introduction.** The fundamental problem of optimal control is to find the control laws that attain a desired aim by optimizing a defined criterion. The success of this discipline lies in the applications which it could handle; among most recent one can mention the works of Peng Shi and al. [17,18]. In the sixties Kalman, Leitman and Luemberger developed methods for solving this class of problem however their efforts did not lead to an analytic solution for non-linear systems [3]. To confront the fact that stationary linear systems are rare, the scientists elaborated numeric methods for solving the non-linear optimal control problem. Among these methods, we mention [4]: Reduction to a linear problem method, Gradient method and Dynamic programming method but all these methods suffered of deficits that make them only applicable for particular problems such as the little dimension problems. Rein Luus [1] elaborated an algorithm based on control region contraction technique that allows, later on, solving the high dimensional non-linear optimal control via the dynamic programming. This method leads to a global optimum however the computing time is significant. Chang and Lee [5] introduced the general orthogonal polynomials but only for solving the analysis and optimal control problems of time varying linear systems. Lee and Chang [6] introduced the non-linear operational matrix for solving the analysis, identification and optimal control problems; however they restricted their investigations to one dimensional case. S. Lapin and N. D. Egupov [2] used the BPFs (block-pulse functions) to, only; analyze the non-linear time varying systems. Shien-Yu Wang [13] developed a general approximation framework for use in optimal problems governed by non-linear differential equations with time delay