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FIRST ORDER STEP RESPONSE IDENTIFICATION FROM NOISY DATA

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Abstract. *In the real world, systems and signals are affected by stochastic perturbations briefly referred to as „noises". Such noises can be generated by unknown sources located either inside or outside of a system and usually corrupt in unknown way the acquired data the system can provide. Depending on the noises power in the acquired data, some characteristics of the system under study can or cannot be determined. This article introduces a method to identify optimal smooth step response, of first order, from noisy data, by means of Newton-Raphson method employed to minimize a quadratic criterion. Simulations with real world data prove the method effectiveness.*

Keywords: step response, quadratic criterion, Newton-Raphson optimization procedure

1. Introduction and problem statement

Automatic Control is a scientific and engineering field that strongly relies on Systems Theory [7], [3], [6], System Identification [8], [4] and Optimization Theory [1], [9], as main pillars. Since its inception, despite the very complex theoretical approach that the above-mentioned theories have reached, a humongous number of automatic control applications were developed. Usual practitioners are mostly interested in applying rather simple theoretical results to real world systems. Nevertheless, lately, in some applications, there is an increasing interest of filling the gap between advanced (often complex) theoretical results and numerical procedures that can be implemented on their basis. For example, in Industrial Automation field [5], very seldom controllers outside the PID class are accepted, whilst, in Aerospace Industry [2], optimal state space controllers are already implemented, although their complexity is sensibly higher.

This article tries to answer a question of interest for many Automatic Control practitioners, namely: how to extract some characteristics of a dynamic system from real world, by using acquired data the system can provide? At a first sight, the problem related to this question should not be so difficult to solve. Nevertheless, complications arise because the signals of real world are corrupted by stochastic perturbations, also referred to as *noises*. Unfortunately, in most cases, one cannot know what the noise sources are, whether they are located

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