DIRECT ESTIMATION OF PHYSICAL PARAMETERS OF AN RLC ELECTRICAL CIRCUIT BY SIXTEEN CONTINUOUS-TIME METHODS

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ABSTRACT

The present has a double objective. The first one is to compare and estimate sixteen continuous-time methods through the identification of a system consisted with an RLC electrical circuit. These sixteen methods are classified into three groups that are the linear filters, the modulating functions and the integral methods. The second objective is to estimate directly the physical parameters of the RLC circuit, without resorting to a discrete-time model. The system is consisted of a coil with inductance L and resistance R, and of a capacitor with capacitance C. Having written the physical equations which describe the behavior of the system, the transfer function in where the initial conditions appear is given. These initial conditions should be taken into account during the parameter estimation phase, because they are inevitable within the framework of real signals. A physical interpretation of the identified models is tempted by the direct estimation of the physical parameters L and C. In conclusion, a classification of the studied methods is proposed.

1. INTRODUCTION

If numerous papers deal with comparative studies of parameter estimation methods in the case of Discrete-Time (DT) model identification, only few comparisons of direct Continuous-Time (CT) model identification methods have been attempted so far: when the comparative study was quite exhaustive, only two methods were considered [1], on the contrary, when the number of compared methods was more important (eight), the comparative study was less complete [2]. However, two works have recently presented comparisons of more CT methods in simulation [3] and on data measured from a laboratory-scale system [4]. One of the advantages of the CT direct identification is to allow the direct estimation of the CT model parameters. This property has been shown in [5], but in these works, only the Hartley modulating functions were used.

This paper aims at two objectives: to propose a comparison of sixteen CT Equation-Error-based methods on real data from an RLC electrical circuit and to estimate the physical parameters of this system. These sixteen methods are distributed in the three classes that are the linear filters, the modulating functions and the integral methods [6]. The paper is organized as follows: section two presents the system and the criterion used in the study, section three provides the results of the identification and validation and give some comments about the results through the estimation of the physical parameters. Section four is constituted by concluding remarks.

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2. SYSTEM AND EXPERIMENTS

2.1 Installation

The considered system is an RLC electrical circuit composed by an inductor with inductance L and resistance R, and a capacitor C (figure 1). The generated input signal is not applied directly to the circuit but goes through an amplifier, because the input-output card installed in the computer does not deliver a sufficient power. Moreover, to overcome some possible problems of mass, the measurements are performed with differential probes which attenuate the signal by a factor 20. However, as the the resolution of the PC card analog-to-digital converters is of 16 bits, this attenuation has no consequence on the quality of the measurements.

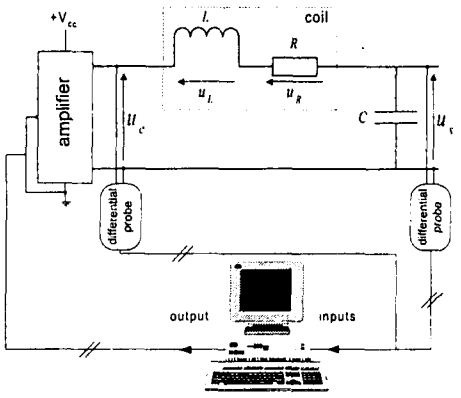

Figure 1. RLC circuit