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IDENTIFICATION OF WIENER MODEL WITH TWO-SEGMENT NONLINEARITIES USING HYBRID OPTIMIZATION APPROACH

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Abstract. In this paper, a novel approach for the identification of Wiener model is proposed by using hybrid Nelder-Mead simplex search and particle swarm optimization (NM-PSO). The static nonlinear function is assumed to be invertible, and we use a two-segment polynomial to approximate its inverse. The proposed method formulates the identification problem as an optimization problem in parameter space. The parameters of linear block as well as nonlinear function are estimated simultaneously through NM-PSO. NM-PSO integrates the fast convergence of NM with the global search of PSO and is very effective to solve complex optimization problem. Experimental results show the effectiveness of the proposed method.

Keywords. Identification, Wiener model, Two-segment polynomial, Nelder-Mead simplex search, Particle swarm optimization.

AMS (MOS) subject classification: 93B30 68T20

1 Introduction

Many physical systems encountered in engineering, communication and biological fields are inherently nonlinear [19]. Usually, these nonlinear systems are approximated by using linear models over a restricted operating range. However, it is well known that linear models are only feasible locally. Only nonlinear representations are adequate for their description. In the literature, Hammerstein model and Wiener model have been extensively used for representing nonlinear systems for their easy identifications and computations. A Wiener model consists of a linear dynamic block followed by a static nonlinear function and it has been successfully used to model a large class of nonlinear systems in a number of practical applications in the area of chemical process [28], biological process [7], communication and control [31].

Identification of Wiener model is of great importance especially for control purpose and has attracted much attention from researchers for a long time.