Nonlinear Dynamics (2005) 39: 1

Introduction

The co-editors were invited by the Editor-in-Chief, Professor Ali Nayfeh, to organize a special issue on the topic of system identification of nonlinear dynamical systems. The task has proven to be a happy one in that we were able to secure an outstanding cadre of authors to address this topic. System identification of linear systems is now a well established and powerful approach to the modeling of such systems. However, the corresponding state of the art for nonlinear systems is still at the research frontier. We hope that the reader will find the following set of articles informative and provocative. Certainly these articles have stimulated our own thinking about this important and fascinating topic.

Most of the articles develop and/or apply techniques which are system identification in the usual sense, i.e., they pose and answer the question, given data on the dynamic response of the system, how can a nonlinear dynamical model be constructed that is computationally efficient and physically accurate? These papers include the ones by Lind, Prazenica and Brenner and Silva that pursue approaches based upon Volterra integral kernels; the one by Thothandri and Moon which addresses generic nonlinear systems exhibiting bifurcations and limit cycle oscillations; the one by Juang that explicitly considers a special class of nonlinear systems, i.e., bilinear systems; the paper by Masri, Caffrey, Caughey, Smyth and Chassiakos that emphasizes the construction of reduced order models; the paper by Zimmerman and Hasselman that pursues approximate models derived from a finite element code; and the paper by Kerschen and Golinval that focuses on the updating of analytical/numerical models using experimental data. However, we have interpreted system identification more broadly for this special issue and also included are two papers on the computation of limit cycle oscillations using reduced order models derived from complex computational models, i.e., the paper by Beran and Lucia and also the paper by Thompson and Strganac. In addition, there is a paper by Bajodah, Hodges and Chen that seeks to find the control forces required to give a desired motion using classical and modern analytical methods and a paper by Epureanu, Yin and Dowell that uses a nonlinear dynamical system approach to detecting damage in structures.

We hope that readers will enjoy and profit from all of these varied approaches to nonlinear system identification.

Earl H. Dowell
Department of Mechanical Engineering & Materials Science
Duke University
Durham, NC 27708, USA
E-mail: dowell@ee.duke.edu

Bogdan I. Epureanu
Department of Mechanical Engineering
University of Michigan
2350 Hayward St.
Ann Arbor, MI 48109-2125, USA
E-mail: epureanu@umich.edu