Identification Of Dynamic Systems An Introduction With Applications Advanced Textbooks In Control And Signal Processing

Some novel approaches to estimate Nonlinear Output Error (NOE) models using TS fuzzy models for a class of nonlinear dynamic systems having variability in their outputs is presented in this dissertation. Instead of using unrealistic assumptions about uncertainty, the most common of which is normality, the proposed methodology tends to capture effects caused by the real uncertainty observed in the data. The methodology requires that the identification method must be repeated offline a number of times under similar conditions. This leads to multiple inputoutput time series from the underlying system. These time series are preprocessed using the techniques of statistics and probability theory to generate the envelopes of response at each time instant. By incorporating interval data in fuzzy modelling and using the theory of symbolic interval-valued data, a TS fuzzy model with interval antecedent and consequent parameters is obtained. The proposed identification algorithm provides for a model for predicting the center-valued response as well as envelopes as the measure of uncertainty in system output.

This book presents a detailed examination of the estimation techniques and problems in dynamic systems. Containing several illustrations and computer programs, the book promotes a better understanding of system modelling and parameter estimation. Parameter estimation involves observation of a dynamic system to develop mathematical models that represent the system dynamics. With the increasing use of high speed digital computers, elegant and innovative techniques like filter error method, H° and artificial neural networks are finding more and more use in parameter estimation problems. The material is presented in an accessible manner and enables the user to implement and execute the programs and, therefore, gain first-hand experience of the estimation progress.

This book contains examples and exercises with modeling problems together with complete solutions. The contents is tailored to the book Ljung-Glad: Modeling and Identification of Dynamic Systems (Studentlitteratur, 2016). The exercises are of different levels of difficulty and cover general modeling principles (such as bond graphs) as well as practical tools like Modelica and Simscape. System identification, model and signal properties are also covered together with basic techniques for simulation. Most of the problems deal with issues from industrial applications, but also economic, social and medical cases are covered.

The text requires certain knowledge in linear algebra, signal and systems and basic familiarity with physics and statistics. The computer exercises assume access to basic software such as Matlab and Simulink, and to some extent Modelica/Dymola/Simscape. The book is suitable for Master level courses in engineering, but also for practicing engineers.

Dynamic System Identification: Experiment Design and Data Analysis

The objective of this work is to study some new inverse problems related to mechanical systems, typical to the theory of vibration and engineering practice.

Precise dynamic models of processes are required for many applications, ranging from control engineering to the natural sciences and economics. Frequently, such precise models cannot be derived using theoretical considerations alone. Therefore, they must be determined experimentally. This book treats the determination of dynamic models based on measurements taken at the process, which is known as system identification or process identification. Both offline and online methods are presented, i.e. methods that post-process the measured data as well as methods that provide models during the measurement. The book is theory-oriented and application-oriented and most methods covered have been used successfully in practical applications for many different processes. Illustrative examples in this book with real measured data range from hydraulic and electric actuators up to combustion engines. Real experimental data is also provided on the Springer webpage, allowing readers to gather their first experience with the methods presented in this book. Among others, the book covers the following subjects: determination of the non-parametric frequency response, (fast) Fourier transform, correlation analysis, parameter estimation with a focus on the method of Least Squares and modifications, identification of time-variant processes, identification in closed-loop, identification of continuous time processes, and subspace methods. Some methods for nonlinear system identification are also considered, such as the Extended Kalman filter and neural networks. The different methods are compared by using a real three-mass oscillator process, a model of a drive train. For many identification methods, hints for the practical implementation and application are provided. The book is intended to meet the needs of students and practicing engineers working in research and development, design and manufacturing.

Mathematical models of real life systems and processes are essential in today's industrial work. To be able to construct such models is therefore a fundamental skill in modern engineering...

This interim report introduces the mathematical development of a new method for identifying system transfer functions from input-output data. Discussion contained herein covers: The mathematical basis for the method; An analytical example to illustrate the application of the method; and, A computer example which provides the groundwork for the practical application of the method.

In this book, a set of relevant, updated and selected papers in the field of automation and robotics are presented. These papers describe projects where topics of artificial intelligence, modeling and simulation process, target tracking algorithms, kinematic constraints of the closed loops, non-linear control, are used in advanced and recent research.

Identification of Dynamic Systems and Selection of Suitable Model.

The report deals with the identification of unknown parameters in dynamic systems. In modeling a physical system, the problem of identifying the dynamics of a system are often encountered. The developed algorithm provides a tool to model all or parts of a dynamic system using input-output data sets from a real system. The methodology and techniques of this algorithm are based upon linear recursive estimation theory. The theoretical foundation and the pragmatics of using the ensemble data to estimate the unknown parameters are discussed at length in the development of the algorithm. As an application of the algorithm, experimental data from a man-in-the-loop simulation is used to estimate the parameters of a single axis model of the gunner. The tracking response of the gunner model compare favorably with data obtained from the simulation. (Modified author abstract).

In the article the author investigates the parametric identification of dynamic systems, i.e. problems which deal with the reconstruction of the characteristics of dynamic objects, known with an accuracy up to a finite number of parameters. This problem is solved first for linear systems and then for nonlinear systems in which a linear model can be identified, and finally for general nonlinear systems. In the latter both necessary and sufficient identification conditions are obtained. Certain special types of dynamic systems are investigated. The basic results are obtained from a study of functional increments. (Author).

This book gives an in-depth introduction to the areas of modeling, identification, simulation, and optimization. These scientific topics play an increasingly dominant part in many engineering areas such as electrotechnology, mechanical engineering, aerospace, and physics. This book represents a unique and concise treatment of the mutual interactions among these topics. Techniques for solving general nonlinear optimization problems as they arise in identification and many synthesis and design methods are detailed. The main points in deriving mathematical models via prior knowledge concerning the physics describing a system are emphasized. Several chapters discuss the identification of black-box models. Simulation is introduced as a numerical tool for calculating time responses of almost any mathematical model. The last chapter covers optimization, a generally applicable tool for formulating and solving many engineering problems.

The objective of this thesis is to estimate the parameters of dynamic systems using the Sliding Mode Control Technique.

Evolutionary Parametric Identification of Dynamic Systems.

System Identification Toolbox provides MATLAB functions, Simulink blocks, and an app for constructing mathematical models of dynamic systems from measured input-output data. It lets you create and use models of dynamic systems not easily modeled from first principles or specifications. You can use time-domain and frequency-domain input-output data to identify continuous-time and discrete-time transfer functions, process models, and state-space models. The toolbox also provides algorithms for embedded online parameter estimation. The toolbox provides identification techniques such as maximum likelihood, prediction-error minimization (PEM), and subspace system identification. To represent nonlinear system dynamics, you can estimate Hammerstein-Weiner models and nonlinear ARX models with wavelet network, tree-partition, and sigmoid network nonlinearities. The toolbox performs grey-box system identification for estimating parameters of a user-defined model. You can use the identified model for system response prediction and plant modeling in Simulink. The toolbox also supports time-series data modeling and time-series forecasting. The most important content that this book provides are the following: - System Identification Overview - What Is System Identification? - About Dynamic Systems and Models - System Identification Requires Measured Data - Building Models from Data - Black-Box Modeling - Grey-Box Modeling - Evaluating Model Quality - When to Use the App vs. the Command Line - System Identification Workflow - Commands for Model Estimation - Linear Model Identification - Identify Linear Models Using System Identification App - Preparing Data for System Identification - Saving the Session - Estimating Linear Models Using Quick Start - Estimating Linear Models - Viewing Model Parameters - Exporting the Model to the MATLAB Workspace - Exporting the Model to the Linear System Analyzer - Identify Linear Models Using the Command Line - Preparing Data - Estimating Impulse Response Models - Estimating Delays in the Multiple-Input System - Estimating Model Orders Using an ARX Model Structure - Estimating Transfer Functions - Estimating Process Models - Estimating Black-Box Polynomial Models - Simulating and Predicting Model Output - Identify Low-Order Transfer Functions (Process Models) - Using

System Identification App - What Is a Continuous-Time Process Model? - Preparing Data for System Identification - Estimating a Second-Order Transfer Function (Process Model) - with Complex Poles - Estimating a Process Model with a Noise Component - Viewing Model Parameters - Exporting the Model to the MATLAB Workspace - Simulating a System Identification Toolbox Model in Simulink Software - Estimating Models Using Frequency-Domain Data - Advantages of Using Frequency-Domain Data - Representing Frequency-Domain Data in the Toolbox - Preprocessing Frequency-Domain Data for Model - Estimation - Estimating Linear Parametric Models - Validating Estimated Model - Next Steps After Identifying a Model - Nonlinear Model Identification - Identify Nonlinear Black-Box Models Using System - Identification App - What Are Nonlinear Black-Box Models? - Preparing Data - Estimating Nonlinear ARX Models - Estimating Hammerstein-Wiener Models