

Studies in Systems, Decision and Control 439

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Advanced Information-Measuring Technologies and Systems I

 Springer

Studies in Systems, Decision and Control

Volume 439

Series Editor

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ISSN 2198-4182

ISSN 2198-4190 (electronic)

Studies in Systems, Decision and Control

ISBN 978-3-031-40717-8

ISBN 978-3-031-40718-5 (eBook)

<https://doi.org/10.1007/978-3-031-40718-5>

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The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The book presents the main scientific directions and issues of research conducted at the Department of Information and Measurement Technologies of the National Technical University of Ukraine “Ihor Sikorskyi Kyiv Polytechnic Institute”. The presented results cover almost all scientific directions related to information and measurement technologies—metrological support of measurement channels of information and measurement systems, methods of reproducing units of electric circuit parameters, development of specialized information and measurement systems, mathematical methods of processing measurement information, models of formation of information signals and fields, statistical diagnostic methods, information support of testing and calibration laboratories.

The book consists of 7 chapters.

Chapter “[Metrological Support of Measurement Channels with Bridge Circuits](#)” presents the design of the simulator of the sensor output voltage, which has the advantages of improved accuracy of the measuring channels calibration. Analysis of the conversion equation was carried out and the method of error correction in bridge circuits of measuring channels was investigated.

Chapter “[Application of Exponential Splines in the Measurement and Control of Electric Circuit Parameters](#)” discusses the practical aspects of using exponential splines in the tasks of measuring and controlling the parameters of electric circuits for the synthesis of test signals of a special form. The advantage of exponential splines is the ease of generation in linear electrical circuits. The formation of test signals and examples of control of the parameters of electric circuits are presented. The influence of the type of approximating functions on the quality of reproduction using the feedback of information about the parameters of the circle and, accordingly, on the error of their determination was analyzed.

Chapter “[Improving of Methods of Impedance Parameters Units Reproduction and Measurement Accuracy Increasing for Ensuring Metrological Traceability](#)” presents a structural-algorithmic method of increasing the accuracy of the calibration of measures of electrical impedance units, as well as a developed calibration method and a method of assessing the uncertainty of measurements when calibrating measures of electrical capacity and inductance of precision LCR-meters. General

approaches to calibration are given, measurement equations (models) are presented, as well as examples of calculation of uncertainty budgets during calibration.

Chapter “[Implementation of Information and Measurement Systems at the Base of Specialized Internet Protocols](#)” gives the organization of distributed microcontroller systems for collecting measurement information with remote Internet access to microserver networks of virtual intelligent sensors based on specialized web protocols. The research method is theoretical and experimental based on the analysis and synthesis of hardware and software of microcontroller network systems for remote collection of experimental data. Structures of intelligent sensors for studying the composition of substances have been developed. A basic set of hardware and software tools for microcontroller modules of intelligent sensors has been developed.

Chapter “[Model of Information Signals Formation in the Diagnostics of Composite Products](#)” presents the structure of information processes for diagnosing products made of composites, which made it possible to analyze the formation of the information field, which became the basis for the development of a mathematical model of the generating information-signal field, which takes into account the main mechanisms of the formation of mechanical disturbances in the composite, in the form of a random Hilbert linear field model. The model made it possible to propose a new method of standard-free diagnosis of products made of composite materials, methods of processing measurement information, definition and construction of vectors of diagnostic signs, and decision-making rules.

Chapter “[Theory and Practice of Ensuring the Validity in Testing Laboratories](#)” shows the necessity of building a systematic model of ensuring the validity to achieve a balance between the customer’s expectations regarding quality and the laboratories’ quality statement and quality concept. The standards that allow applying qualitative and quantitative methods of validity assurance are considered. The algorithm of actions to improve the reliability of test results depending on the identified risks, available financial and human resources, and adopted quality goals is shown. Also, Chapter “[Theory and Practice of Ensuring the Validity in Testing Laboratories](#)” discusses the features of the organization of ensuring the validity in testing laboratories. The processes in the laboratory were analyzed in terms of the requirements of the ISO 17025 standard and the developed system model of ensuring the reliability. Examples of practical assurance measures for processes are given: equipment and personnel management facilities, deviation from the contract, externally provided products, LIMS, impartiality, sampling, risk management, managements reviews, and improvement. The role of method validation to ensure a validity is defined. The uncertainty of the result is considered as one of the options for generalizing the quantitative indicator of validity. The algorithm of actions to improve the reliability of test results depending on the identified risks, available financial and human resources, and adopted quality goals is shown.

Chapter “[Methodology for Controlling Greenhouse Microclimate Parameters and Yield Forecast Using Neural Network Technologies](#)” presents structural schema of the greenhouse control and monitoring system. The creation of a methodology using neural network technologies is intended to control the parameters of the greenhouse microclimate, which should have a positive influence on the quality of the

harvest and increase yields. The optimal greenhouse microclimate conditions were also analyzed and determined: temperature, humidity, and carbon dioxide concentration, according to which it is possible to predict the yield. Based on the mathematical model, a program was designed to train the neural network. For an accurate forecast, a neural network was developed that is based on a multilayer perceptron with three hidden layers.

The authors will be grateful to all readers who will send feedback, comments, and suggestions on the material presented in the book.

Kyiv, Ukraine
March 2023

Volodymyr Eremenko
Artur Zaporozhets

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