

Book review

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Book: Principles of Uncertainty Evaluation in Electrical Measurement

Hoda Aleali ^{1*}, Mahmoud Fasih ¹

1. Department of metrology, Research Center of Quality Assessment and Management Systems, Standard Research Institute, Karaj, Iran.

Abstract

Electrical measurement is a crucial part of calibration and standard conformity assessment. The main concern in a measurement process is its metrological credibility (i.e. how close/ far is the measurement result to the actual measurand) which is expressed in terms of measurement uncertainty. Measurement uncertainty is of vital importance specially when the measurement results are used by judicial authorities, commercial and fiscal stake beneficiaries, law enforcement personnel or healthcare professionals. For example, when the result of a blood glucose test is relied upon to determine whether a patient needs medication, the measurement uncertainty becomes decisive. For a test expert either involved directly or indirectly in the measurement process or any relevant field, it is of utmost significance to have a hands-on expertise of uncertainty evaluation techniques. This book elaborates the principles of measurement uncertainty evaluation in electrical measurement and explores some important related subjects as well as the most important and frequent applications. In order to explore the uncertainty concepts, the book first introduce some basic definitions and discuss concepts from the scientific literature and international standards. Some relevant discussions regarding the components and working principles of measurement systems are also included. The main portion of the book is dedicated to the subject of uncertainty evaluation which is stated via several examples. Uncertainty evaluation is accomplished by identification of a cause-and-effect diagram and formation of an uncertainty budget.

Keywords Uncertainty evaluation, Measurement Uncertainty, Uncertainty Budget, Electrical Measurement.

1. Introduction

Electrical measurement is a crucial part of calibration and standard conformity assessment. The main concern in a measurement process is its metrological credibility (i.e. how close/ far is the measurement result to the actual measurand) which is expressed in terms of measurement uncertainty. Measurement uncertainty is of vital importance specially when the measurement results are

used by judicial authorities, commercial and fiscal stake beneficiaries, law enforcement personnel or healthcare professionals. For example, when the result of a blood glucose test is relied upon to determine whether a patient needs medication, the measurement uncertainty becomes decisive. For a test expert either involved directly or indirectly in the measurement process or any relevant field, it is of utmost significance to have a hands-on expertise of



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* Correspondence:
hoda.aleali@gmail.com



uncertainty evaluation techniques.

Any test or calibration laboratory shall have a procedure for evaluating the measurement uncertainty of their measurement. The resulting data shall be recorded in such a way that trends are detectable and, where practicable, statistical techniques shall be applied to review the results. This monitoring shall be planned and reviewed and then referring to both internal quality control and proficiency testing, data from monitoring activities shall be analyzed, used to control and, if applicable, improve the laboratory's activities. If the results of the analysis of data from monitoring activities are found to be outside pre-defined criteria, appropriate action shall be taken to prevent incorrect results from being reported.

This book review is dedicated to introduce and discuss the recently published book entitled as "Principles of uncertainty evaluation in electrical measurement".

Book description

The bibliographical information of the book are as follows: Share Pasand, Mohammad Mahdi and Ali Tavakoli Golpaygani, Principles of Uncertainty Evaluation in Electrical Measurement, Standard Research Institute Press, Jun. 2024, Karaj, Iran.

The book is published in Persian. The publisher; Standards Research Institute press, publishes applied and theoretical books relevant to the fields of testing, quality control, standardization and conformity assessment. Authors have more than a decade experience in conformity assessment laboratories and have been collaborating in laboratory accreditation for ISO/IEC 17025 compliance [2]. The book contains 251 pages, 34 figures, 24 tables and

more than 15 numerical examples discussing the derivation of statistical figures required for laboratory quality control in real world applications.

Significance of the subject

Electrical measurement has an increasingly important role in our daily lives. A laboratory willing to attain reliable (repeatable and reproducible) results and maintain a high statue with regard to customer satisfaction, will need to evaluate its measurement uncertainty. For a quality manager working at such a laboratory, it is crucial to understand and effectively practice the concepts and methods described in this book.

Readership

"Principles of uncertainty evaluation in electrical measurement" is easy to follow. Nevertheless, some parts of the 4th chapter, may be challenging for those readers not familiar with statistical estimation techniques. The 5th chapter requires background education and/or experience in instrumentation and electronics engineering. The 6th chapter requires a specifically relevant background in electromagnetics and instrumentation. These two chapters may deem complicated even for graduate level readers from other branches of engineering. The target audience of the book are those laboratory experts in the field of electrical, electronics, electromagnetics and instrumentation engineering who are mostly focused on technical aspects of their works but need to have a good practical skill to do uncertainty calculations for their own. The book can be viewed as a companion to [3] previously published by the same authors on quality control techniques.

Structure and organization

This book elaborates the principles of measurement uncertainty evaluation in electrical measurement and explores some important related subjects as well as the most important and frequent applications. In order to explore the uncertainty concepts, the book firstly introduce some basic definitions and discuss concepts from the scientific literature and international standards. Some relevant discussions regarding the components and working principles of measurement systems are also included. The main portion of the book is dedicated to the subject of uncertainty evaluation which is stated via several examples. Uncertainty evaluation is accomplished by identification of a cause-and-effect diagram and formation of an uncertainty budget.

In the following, the main contents of each chapter are given: The first chapter introduces the international system of units, international metrology institutions and relevant concepts.

The second chapter is dedicated to basic concepts, terms and definitions. The definitions are drawn from international standards vocabulary, especially the international vocabulary of metrology. Some definitions are drawn from textbooks of instrumentation and measurement engineering.

The third chapter discusses measurement uncertainty evaluation. This chapter introduces the main components of an uncertainty budget and explores the method for measurement uncertainty calculation in accordance to ISO Guide 98-1 [4].

The fourth chapter discusses uncertainty of the parameter estimation process as an indirect measurement method.

The fifth chapter is dedicated to signal conditioning circuits. This chapter highlights the important role of the conditioning circuit on the measurement results.

The sixth chapter is dedicated to measurement uncertainty in electromagnetic compatibility testing. This chapter may be skipped by those readers who are not involved in electromagnetic compatibility tests.

The book contains an appendix explaining decision rules for binary decisions on standard conformity.

A Persian-to-English and an English-to-Persian glossary are also included in the book for reader convenience.

Novelty and Innovation

The book enjoys a smooth, uniform and simple tone. It contains several numerical examples which are followed by insightful discussions. The authors compare the results of several examples to broaden the readers perspective on the subject.

Conclusion

In this book review, a recently published book titled: “Principles of uncertainty evaluation in electrical measurement “ is introduced and reviewed. Content, chapters, practicality and innovative aspects of the book are briefly

discussed. The book provides a concise and comprehensive resource that covers the book’s content, application areas, and innovative aspects. With its strengths lying in clarity and inclusion of examples, the book effectively aids in understanding measurement uncertainty concepts and practical calculations of uncertainty budgets.

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Not applicable.

Consent for publication

Not applicable.

Competing interests

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