

# Section 3.1

## Measurements and Their Uncertainty

- OBJECTIVES:
  - Distinguish among accuracy, precision, and error of a measurement.

# Section 3 1 Measurements And Their Uncertainty

**René Alt, Andreas Frommer, R. Baker  
Kearfott, Wolfram Luther**

### Section 3 1 Measurements And Their Uncertainty:

Measurements and Their Uncertainties Ifan Hughes, Thomas Hase, 2010-07 This short guide to modern error analysis is primarily intended to be used in undergraduate laboratories in the physical sciences No prior knowledge of statistics is assumed The necessary concepts are introduced where needed and illustrated graphically The book emphasises the use of computers for error calculations and data fitting

**Test bench design for power measurement of inverter-operated machines in the medium voltage range** Schneider, Simon Michael, 2018-12-21 This thesis gives an overview of test bench design for inverter operated Medium Voltage MV drives with the focus on the active power measurement The sources of measurement setup uncertainty are analysed and methods are shown to assess these uncertainties Further a possibility is shown to do quantitative uncertainty estimations which are verified with measurements through different measurement setups for MV drives operated with multilevel converters The influence of measurement transducers voltage dividers power meters and data acquisition boards are considered The digital signal processing is analysed and the possibilities to reduce its uncertainty contribution on an active power measurement is shown An analysis is made with the conventional measurement devices in the MV range The transfer behaviour of the devices and the characteristics of the uncertainty are investigated Measurements are done on typical medium voltage drives with an uncertainty analysis which shows the essential aspects of active power measurement The results show the significance of a measurement setup performance The investigations on the drives are used to indicate the impact on the determination of the drive efficiency and gives a significant input for further standardisation processes The handling of measurement uncertainties during active power measurement of drives is shown concerning the permanent topic of energy saving and its efficient use The work proposes a way of categorising electrical drives in energy efficiency classes and to make their determination comparable Die vorliegende Dissertation gibt einen Überblick über den Prüfstands Aufbau von Umrichtergetriebenen Mittelspannungsantrieben Die Unsicherheitsquellen werden analysiert und Methoden werden aufgezeigt um die Messunsicherheit zu bewerten Des Weiteren werden die Machbarkeit von Unsicherheitsabschätzungen gezeigt welche mit Messungen an typischen Mittelspannungsantrieben mit Umrichterspeisung verglichen werden Der Einfluss von Messwandlern Spannungsteilern Leistungsmessern und Messkarten zur Signalerfassung wird berücksichtigt Die digitale Signalverarbeitung wird analysiert um den Unsicherheitsbeitrag zur Wirkleistungsmessung zu reduzieren Es werden konventionellen Messwandler und teiler im Mittelspannungsbereich bezüglich ihres Übertragungsverhaltens sowie Messunsicherheiten untersucht Die Ergebnisse der Untersuchungen verdeutlichen die Signifikanz eines performanten Messaufbaus Des Weiteren werden Auswirkungen auf die Bestimmung der Effizienz aufgezeigt Die Arbeit liefert einen wesentlichen Beitrag für weitere Standardisierungsprozesse Der Umgang mit Messunsicherheiten der Wirkleistungsmessung wird betrachtet im Hinblick auf Energieeinsparpotenziale und deren effiziente Nutzung Die Arbeit schlägt eine Möglichkeit vor wie elektrische Antriebe in Energieeffizienzklassen kategorisiert

werden können um diese vergleichbar zu machen      *Surveying Measurements and Their Analysis* R. B. Buckner, 1983

Custody Transfer and Fiscal Flow Measurement by Ultrasonic Meters Alcir de Faro Orlando, 2024-05-21 This book describes how to calibrate measure and specify ultrasonic flow meters to ensure that the legal metrology requirements are met in custody transfer and fiscal applications This book is intended for metrologists who are in charge of specifying ultrasonic flow meters calibrating or accurately measuring water oil and natural gas flowrate in custody transfer and fiscal measurement applications and require a deep knowledge of the measurement principles and the results that can be achieved so that the legal metrology requirements can be met      **Chemical Analysis of Antibiotic Residues in Food** Jian

Wang, James D. MacNeil, Jack F. Kay, 2011-11-29 An insightful exploration of the key aspects concerning the chemical analysis of antibiotic residues in food The presence of excess residues from frequent antibiotic use in animals is not only illegal but can pose serious health risks by contaminating products for human consumption such as meat and milk Chemical Analysis of Antibiotic Residues in Food is a single source reference for readers interested in the development of analytical methods for analyzing antibiotic residues in food It covers themes that include quality assurance and quality control antibiotic chemical properties pharmacokinetics metabolism distribution food safety regulations and chemical analysis In addition the material presented includes background information valuable for understanding the choice of marker residue and target animal tissue to use for regulatory analysis This comprehensive reference Includes topics on general issues related to screening and confirmatory methods Presents updated information on food safety regulation based on routine screening and confirmatory methods especially LC MS Provides general guidance for method development validation and estimation of measurement uncertainty Chemical Analysis of Antibiotic Residues in Food is written and organized with a balance between practical use and theory to provide laboratories with a solid and reliable reference on antibiotic residue analysis Thorough coverage elicits the latest scientific findings to assist the ongoing efforts toward refining analytical methods for producing safe foods of animal origin      **Basic Concepts of Chemistry** Leo J. Malone, Theodore Dolter, 2008-12-03 Engineers who need to have a

better understanding of chemistry will benefit from this accessible book It places a stronger emphasis on outcomes assessment which is the driving force for many of the new features Each section focuses on the development and assessment of one or two specific objectives Within each section a specific objective is included an anticipatory set to orient the reader content discussion from established authors and guided practice problems for relevant objectives These features are followed by a set of independent practice problems The expanded Making it Real feature showcases topics of current interest relating to the subject at hand such as chemical forensics and more medical related topics Numerous worked examples in the text now include Analysis and Synthesis sections which allow engineers to explore concepts in greater depth and discuss outside relevance      **NASA Technical Memorandum** , 1989      *Numerical Software with Result Verification* René Alt, Andreas Frommer, R. Baker Kearfott, Wolfram Luther, 2004-02-12 Reliable computing techniques are essential if the validity of the

output of a numerical algorithm is to be guaranteed to be correct Our society relies more and more on computer systems Usually our systems appear to work successfully but there are sometimes serious and often minor errors Validated computing is one essential technology to achieve increased software reliability Formal logic in the definition of data types the computer arithmetic in algorithm design and in program execution allows us to guarantee that the stated problem has or does not have a solution in an enclosing interval we compute If the enclosure is narrow we are certain that the result can be used Otherwise we have a clear warning that the uncertainty of input values might be large and the algorithm and the model have to be improved The use of interval data types and algorithms with controlled rounding and result verification capture uncertainty in modeling and problem formulation in model parameter estimation in algorithm truncation in operation round off and in model interpretation The techniques of validated computing have proven their merits in many scientific and engineering applications They are based on solid and interesting theoretical studies in mathematics and computer science Contributions from fields including real complex and functional analysis semigroups probability statistics fuzzy interval analysis fuzzy logic automatic differentiation computer hardware operating systems compiler construction programming languages object oriented modeling parallel processing and software engineering are all essential *Optical Engineering* ,2004 Publishes papers reporting on research and development in optical science and engineering and the practical applications of known optical science engineering and technology

**System Identification (SYSID '03)** Paul Van Den Hof,Bo Wahlberg,Siep Weiland,2004-06-29 The scope of the symposium covers all major aspects of system identification experimental modelling signal processing and adaptive control ranging from theoretical methodological and scientific developments to a large variety of engineering application areas It is the intention of the organizers to promote SYSID 2003 as a meeting place where scientists and engineers from several research communities can meet to discuss issues related to these areas Relevant topics for the symposium program include Identification of linear and multivariable systems identification of nonlinear systems including neural networks identification of hybrid and distributed systems Identification for control experimental modelling in process control vibration and modal analysis model validation monitoring and fault detection signal processing and communication parameter estimation and inverse modelling statistical analysis and uncertainty bounding adaptive control and data based controller tuning learning data mining and Bayesian approaches sequential Monte Carlo methods including particle filtering applications in process control systems motion control systems robotics aerospace systems bioengineering and medical systems physical measurement systems automotive systems econometrics transportation and communication systems Provides the latest research on System Identification Contains contributions written by experts in the field Part of the IFAC Proceedings Series which provides a comprehensive overview of the major topics in control engineering

**Mobile Robotics** Alonzo Kelly,2013-11-11 Introduction Math fundamentals Numerical methods Dynamics Optimal estimation State estimation Control Perception Localization and mapping Motion

planning     **Journal of Research of the National Institute of Standards and Technology**, 1998     Intelligent System and Computing Yang Yi, 2020-04-29 The book *Intelligent System and Computing* reports the theory mathematical models algorithms design methods and applications of intelligent systems and computing It covers various disciplines including computer and information science electrical and computer engineering natural sciences economics and neuroscience The broad ranging discussion covers the key disciplines in computational science and artificial intelligence as well as advances in neuromorphic computing deep learning the Internet of Things computer vision and many others This volume provides both academics and professionals with a comprehensive overview of the field and presents areas for future research

**Measurement in Fluid Mechanics** Stavros Tavoularis, Jovan Nedić, 2024-04-11 Thoroughly revised and expanded the new edition of this established textbook equips readers with a robust and practical understanding of experimental fluid mechanics Enhanced features include improved support for students with emphasis on pedagogical instruction and self learning end of chapter summaries 127 examples 165 problems and refined illustrations plus new coverage of digital photography frequency analysis of signals and force measurement It describes comprehensively classical and modern methods for flow visualisation and measuring flow rate pressure velocity temperature concentration forces and wall shear stress alongside supporting material on system response measurement uncertainty signal analysis data analysis optics laboratory apparatus and laboratory practice Instructor resources include lecture slides additional problems laboratory support materials and online solutions Ideal for senior undergraduate and graduate students studying experimental fluid mechanics this textbook is also suitable for an introductory measurements laboratory and is a valuable resource for practising engineers and scientists in experimental fluid mechanics     **Handbook of the Speed of Sound in Real Gases**

Allan J. Zuckerwar, 2002-09-10 After the introductory chapters in each volume the material in each chapter starts out with definitions and engineering formulas applies these to the individual gases and proceeds to advanced theory at the molecular level The formulas and theory are illustrated with examples throughout Uncertainty in both measurement and prediction is a recurring theme throughout both volumes The engineering formulas are suited to engineering and science students at the undergraduate level The advanced theory is for professionals and students at the graduate level The Handbook will survey the state of the art from 1921 to the present pointing out gaps in our present knowledge     Smartphone-Based 3D Indoor Localization and Navigation Frank Ebner, 2021-01-10 During the last century navigation systems have become ubiquitous and guide drivers cyclists and pedestrians towards their desired destinations While operating worldwide they rely on line of sight conditions towards satellites and are thus limited to outdoor areas However finding a gate within an airport a ward within a hospital or a university s auditorium also represent navigation problems To provide navigation within such indoor environments new approaches are required This thesis examines pedestrian 3D indoor localization and navigation using commodity smartphones A desirable target platform always at hand and equipped with a multitude of sensors The IMU

accelerometer gyroscope magnetometer and barometer allow for pedestrian dead reckoning that is estimating relative location changes Absolute whereabouts can be determined via Wi Fi an infrastructure present within most public buildings or by using Bluetooth Low Energy Beacons as inexpensive supplement The building s 3D floorplan not only enables navigation but also increases accuracy by preventing impossible movements and serves as a visual reference for the pedestrian All aforementioned information is fused by recursive density estimation based on a particle filter The conducted experiments cover both theoretical backgrounds and real world use cases All discussed approaches utilize the infrastructure found within most public buildings are easy to set up and maintain Overall this thesis results in an indoor localization and navigation system that can be easily deployed without requiring any special hardware components Advanced Mathematical And Computational Tools In Metrology Iv Patrizia Ciarlini,Franco Pavese,Caparica D Richter,Alistair B Forbes,2000-01-22

Advances in metrology depend on improvements in scientific and technical knowledge and in instrumentation quality as well as better use of advanced mathematical tools and development of new ones In this volume scientists from both the mathematical and the metrological fields exchange their experiences Industrial sectors such as instrumentation and software are likely to benefit from this exchange since metrology has a high impact on the overall quality of industrial products and applied mathematics is becoming more and more important in industrial processes This book is of interest to people in universities research centers and industries who are involved in measurements and need advanced mathematical tools to solve their problems and to those developing such mathematical tools **Preliminary Report on the Thermodynamic Properties of Selected Light-element and Some Related Compounds** ,1968 Mechanical Measurements S.P.

Venkateshan,2021-07-01 p This book focuses both on the basics and more complex topics in mechanical measurements such as measurement errors statistical analysis of data regression analysis heat flux measurement of pressure and radiation properties of surfaces End of chapter problems solved illustrations and exercise problems are presented throughout the book to augment learning It is a useful reference for students in both undergraduate and postgraduate programs *Bayesian Compendium* Marcel van Oijen,2020-09-17 This book describes how Bayesian methods work Its primary aim is to demystify them and to show readers Bayesian thinking isn t difficult and can be used in virtually every kind of research In addition to revealing the underlying simplicity of statistical methods the book explains how to parameterise and compare models while accounting for uncertainties in data model parameters and model structures How exactly should data be used in modelling The literature offers a bewildering variety of techniques and approaches Bayesian calibration data assimilation Kalman filtering model data fusion etc This book provides a short and easy guide to all of these and more It was written from a unifying Bayesian perspective which reveals how the multitude of techniques and approaches are in fact all related to one another Basic notions from probability theory are introduced Executable code examples are included to enhance the book s practical use for scientific modellers and all code is available online as well

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