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Measurement Uncertainty in Forensic Science
Uncertainty Quantification in Ocean State Estimation
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Quantifying Uncertainty in Analytical Measurement
Measurement Uncertainty in Chemical Analysis
Experimental Methods for Science and Engineering Students
An Introduction to Measurement Uncertainty
Experimental Uncertainty Analysis: A Textbook for Science and Engineering Students
Evaluating Measurement Accuracy
Theory and Applications of Monte Carlo Simulations
State Estimation, Planning, and Behavior Selection Under Uncertainty for Autonomous Robotic Exploration in Dynamic Environments
The Effects of Incorporating Dynamic Data on Estimates of Uncertainty
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Comparison of Three Methods of Estimating Task Specific Measurement Uncertainty for a Coordinate Measuring Machine
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Uncertainty, Calibration and Probability
Uncertainties in the Estimation of Radiation Risks and Probability of Disease Causation
Estimating Uncertainties in Integrated Reservoir Studies
Statistical Methods for Estimating the Uncertainty in the Best Basis Inventories
Comparative Estimates of Uncertainty in Measurements of Fracture Toughness
Uncertainty Analysis of Experimental Data with R
Estimating Uncertainty in Measurements Made on Materials AP-T79-08

REYNA LARSEN

Estimation of Uncertainty in the Structurebornesound Power Transmission from Asource to a Receiver Springer Science & Business Media

A COMPLETE UPDATE AND REVISION OF THE CLASSIC TEXT "At last, a manual of operations for comparing the cost-effectiveness of a preventive service with a treatment intervention." --American Journal of Preventive Medicine Twenty years after the first edition of COST-EFFECTIVENESS IN HEALTH AND MEDICINE established the practical benchmark for cost-effectiveness analysis, this completely revised edition of the classic text provides an essential resource to a new generation of practitioners, students, researchers, and policymakers. Produced by the Second Panel on Cost-Effectiveness in Health and Medicine--a team of 13 experts from fields including decision science, economics, ethics, psychology, and medicine--this new edition is a comprehensive guide to the use of cost-effectiveness analysis as an evaluative tool at the institutional and policy levels. As health care systems face increasing pressure to derive maximum value from expenditures, the guidelines in this new text represent not just the best information available, but a vital guide to health care decision-making in a challenging new era. Completely revised and enriched with examples and expanded coverage, this second edition of COST-EFFECTIVENESS IN HEALTH AND MEDICINE builds on its predecessor's excellence, offering required reading for both analysts and decision makers.

Measurement Uncertainty in Forensic Science Frontiers Media SA

Petroleum exploration and development are capital intensive and smart economic decisions that need to be made to profitably extract oil and gas from the reservoirs. Accurate quantification of uncertainty in production forecasts will help in assessing risk and making good economic decisions. This study investigates the effect of combining dynamic data with the uncertainty in static data to see the effect on estimates of uncertainty in production forecasting. Fifty permeability realizations were generated for a reservoir in west Texas from available petrophysical data. We quantified the uncertainty in the production forecasts using a likelihood weighting method and an automatic history matching technique combined with linear uncertainty analysis. The results were compared with the uncertainty predicted using only static data. We also investigated approaches for best selecting a smaller number of models from a larger set of realizations to be history matched for quantification of uncertainty. We found that incorporating dynamic data in a reservoir model will result in lower estimates of uncertainty than considering only static data. However, incorporation of dynamic data does not guarantee that the forecasted ranges will encompass the true value. Reliability of the forecasted ranges depends on the method employed. When sampling multiple realizations of static data for history matching to quantify uncertainty, a sampling over the entire range of realization likelihoods shows larger confidence intervals and is more likely to encompass the true value for predicted fluid recoveries, as compared to selecting the best models.

Springer Science & Business Media

Problems after each chapter

Uncertainty Quantification in Ocean State Estimation National Council on Radiation

"This would be an excellent book for undergraduate, graduate and beyond....The style of writing is easy to read and the author does a good job of adding humor in places. The integration of basic programming in R with the data that is collected for any experiment provides a powerful platform for analysis of data.... having the understanding of data analysis that this book offers will really help researchers examine their data and consider its value from multiple perspectives – and this applies to people who have small AND large data sets alike! This book also helps people use a free and basic software system for processing and plotting simple to complex functions." Michelle Pantoya, Texas Tech University Measurements of quantities that vary in a continuous fashion, e.g., the pressure of a gas, cannot be measured exactly and there will always be some uncertainty with these measured values, so it is vital for researchers to be able to quantify this data. Uncertainty Analysis of Experimental Data with R covers methods for evaluation of uncertainties in experimental data, as well as predictions made using these data, with implementation in R. The books discusses both basic and more complex methods including linear regression, nonlinear regression, and kernel smoothing curve fits, as well as Taylor Series, Monte Carlo and Bayesian approaches. Features: 1. Extensive use of modern open source software (R). 2. Many code examples are provided. 3. The uncertainty analyses conform to accepted professional standards (ASME). 4. The book is self-contained and includes all necessary material including chapters on statistics and programming in R. Benjamin D. Shaw is a professor in the Mechanical and Aerospace Engineering Department at the University of California, Davis. His research interests are primarily in experimental and theoretical aspects of combustion. Along with other courses, he has taught undergraduate and graduate courses on engineering experimentation and uncertainty analysis. He has published widely in archival journals and became an ASME Fellow in 2003.

Cost-Effectiveness in Health and Medicine Univ Science Books

Summary: "This document provides some guidelines on the estimation of measurement uncertainty and sampling variation. The procedures are demonstrated through a worked example based on a soil moisture content test. Estimation of the standard deviation for each source of uncertainty and the sensitivity of the source of uncertainty are discussed extensively. Additional examples are used to illustrate some of the concepts. In addition to working through the example, some ideas are proposed on how readers may obtain estimates of sensitivities to variables that do not directly impact on the calculation of the measurand. Three appendices are included covering, methods of calculating the total uncertainty, analysis of inter-laboratory trials and sampling variance when estimating a lot average."--Publisher description.

An Introduction to Risk and Uncertainty in the Evaluation of Environmental Investments Addison-Wesley

"This introduction to measurement uncertainty is intended for metrology professionals working in calibration laboratories and metrology institutes, as well as students in tertiary-level science and engineering programmes. The subject matter is presented with an emphasis on developing models of the physical measurement process. The level of mathematics and statistics used is basic and is typically covered by high school studies"--

Distributor's website.

Bayesian Analysis and Uncertainty in Economic Theory Springer

Forlagets beskrivelse: NCRP Report No. 171, Uncertainties in the Estimation of Radiation Risks and Probability of Disease Causation, considers the types and magnitude of the several uncertainties that are a component of the risk assessment process for cancer, heritable and noncancer effects following radiation exposure. These uncertainties can result from the nature of the input data as well as from the specific analysis and models used for developing the risk estimates. Topics addressed in this Report include: (a) uncertainties associated with extrapolation of dose-response relationships observed in primary epidemiological studies to estimate the risk per unit dose (i.e., organ dose or whole-body dose) in the U.S. population and other exposed populations; (b) applications of meta-analyses or pooled analyses to increase the statistical power in evaluating uncertainties in dose-response relationships for exposed human populations; (c) uncertainties associated with extrapolation of dose-response relationships observed for populations exposed to acute doses of high-energy gamma rays to estimate the risk per unit dose in populations exposed to fractionated or low-dose rate chronic exposures; (d) uncertainties associated with extrapolation of the dose-response relationships observed for populations exposed to high-energy gamma rays to estimate the risk per unit dose in populations exposed to low-energy photons, low-energy electrons, alpha particles, and neutrons with various energies; (e) comparison of uncertainties associated with risk estimated for individual tissue or organ sites with the uncertainties associated with estimating risk of all tumors combined due to whole-body exposure; (f) evaluation of opportunities for using additional epidemiological and laboratory-based biological information to modify estimates of uncertainty in risk estimation for cancer, noncancer effects, and severe heritable disorders; (f) procedures for accounting for dose uncertainty in epidemiological dose-response analyses; and (g) evaluation of the combined effect of uncertainty in dose estimation with the uncertainty in estimation of risk per unit dose in estimating the overall risk. This Report also provides a comprehensive analysis of uncertainties on the estimation of probability of radiation-induced disease, including: (1) application of organ doses and associated uncertainties in estimation of probability of disease causation; (2) evaluation of inherent uncertainties in calculating the probability of disease causation (in an individual), or assigned share of excess relative risk for various types of cancer attributable to radiation exposure; and (3) methods of improving existing procedures for estimating disease probability based on input organ doses and their uncertainties. The issue of uncertainty in estimation of radiation-induced risks of cancer, noncancer diseases, and heritable genetic effects analyzed in this Report is of great importance in evaluating the effects of ionizing radiation on human health, in decisions involving the safe use of ionizing radiation and in addressing public controversy. Uncertainty analyses should become increasingly important in the future as the sophisticated methodologies continue to develop and become more available.

Sensitivity and Uncertainty Analysis to Burn-up Estimates on ADS Using ACAB Code National Academies Press

Measurement shapes scientific theories, characterises improvements in manufacturing processes and promotes efficient commerce. In concert with measurement is uncertainty, and students in science and engineering need to identify and quantify uncertainties in the measurements they make. This book introduces measurement and uncertainty to second and third year students of science and engineering. Its approach relies on the internationally recognised and recommended guidelines for calculating and expressing uncertainty (known by the acronym GUM). The statistics underpinning the methods are considered and worked examples and exercises are spread throughout the text. Detailed case studies based on typical undergraduate experiments are included to reinforce the principles described in the book. This guide is also useful to professionals in industry who are expected to know the contemporary methods in this increasingly important area. Additional online resources are available to support the book at www.cambridge.org/9780521605793.

Influence of Evaporation, Ground Water, and Uncertainty in the Hydrologic Budget of Lake Lucerne, a Seepage Lake in Polk County, Florida Oxford University Press

Measurement of a stress intensity factor using a compact sandwich specimen involves other material properties such as elastic moduli and Poisson's ratios of interlayer and holder materials, and therefore it affects uncertainty. No attempt was made in the past to quantify the uncertainty due to the systematic effects involved in the measurement a of stress intensity factor (K) using a compact sandwich specimen and energy release rate (G) by the elastic compliance technique. Analysis of Type-B uncertainty gave comparative estimates of uncertainties in (1) Mode I stress intensity factor obtained from CT test, CS test, and CS test of negligible interlayer thickness (h->0), (2) Mode I energy release rate using elastic compliance (EC) technique, and (3) Indirect stress intensity factor obtained using the relation with energy release rate. Using a set of nominal values of cadaver bone tests of a specimen-size bovine femur and a set of instrument/sensor errors and specimen dimension tolerances, without the consideration of a series of experimental/statistical data, gave estimates of type B uncertainty. The analysis additionally gave percentage contributions of (1) relevant sources of uncertainty namely, caliper, tolerance of specimen dimensions, load cell and displacement sensor, and (2) individual parameters like load, specimen dimensions, and material constants included in the formulae, towards the uncertainty in fracture toughness measures. This study provided an understanding of the role of sensor, instrument, and specimen fabricating machine errors on the tests considered. Proportional variation in uncertainty of different measures of fracture toughness was verified for different sizes of specimens. This study showed that the selection of instruments/sensors of viable error levels would scale down the uncertainty of fracture toughness measures obtained by the CS test, and brought it very close to that of the CT test of the same specimen size, with a difference of less than 0.05 %.

Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results (rev. Ed.) DIANE Publishing

Uncertainty in structural dynamics is of growing concern to numerous industries. Significant attention has previously been devoted to the study of frequency response functions, however the uncertainty associated with excitation of structures by structureborne sound sources has received little attention. In this work, the uncertainty in the structure borne sound power transmitted from a vibration source into a receiving structure is considered. A method is presented whereby the uncertainties in the active and dynamic properties of a structure borne sound source and its receiver structure are propagated through to the

injected power. Consideration is given to the case where the data describing the source and receiver is incomplete and is therefore termed?granular?. An approach for the estimation of the mean and uncertainty of granular variables is developed and it is shown that by estimating the mean and uncertainty of the missing elements the uncertainty propagation approach can be used for a?granular? case. This approach is illustrated using an example in which the free velocity phase data is assumed to be unavailable. Idealised structure borne sound sources are created analytically in order to examine the validity of the presented methods. Good correlation is observed between the estimated uncertainties in the transmitted power and the uncertainties obtained through a Monte Carlo analysis. Insight into the frequency regions where large uncertainties can be expected in the transmitted structure borne sound power is obtained. It is argued that by providing estimates for the uncertainty of a prediction of the transmitted power, an insight into the reliability of the estimate is achieved, allowing engineering decisions to be made with greater confidence.

An Introduction to Uncertainty in Measurement CRC Press

This paper describes a methodology for the estimation of measurement uncertainty for the contour method, where the contour method is an experimental technique for measuring a two-dimensional map of residual stress over a plane. Random error sources including the error arising from noise in displacement measurements and the smoothing of the displacement surfaces are accounted for in the uncertainty analysis. The output is a two-dimensional, spatially varying uncertainty estimate such that every point on the cross-section where residual stress is determined has a corresponding uncertainty value. Both numerical and physical experiments are reported, which are used to support the usefulness of the proposed uncertainty estimator. The uncertainty estimator shows the contour method to have larger uncertainty near the perimeter of the measurement plane. For the experiments, which were performed on a quenched aluminum bar with a cross section of 51 × 76 mm, the estimated uncertainty was approximately 5 MPa ([sigma]/E = 7 · 10−5) over the majority of the cross-section, with localized areas of higher uncertainty, up to 10 MPa ([sigma]/E = 14 · 10−5).

Quality Assurance in the Analytical Chemistry Laboratory Oxford University Press

All measurements are subject to error because no quantity can be known exactly; hence, any measurement has a probability of lying within a certain range. The more precise the measurement, the smaller the range of uncertainty. Uncertainty, Calibration and Probability is a comprehensive treatment of the statistics and methods of estimating these calibration uncertainties. The book features the general theory of uncertainty involving the combination (convolution) of non-Gaussian, student t, and Gaussian distributions; the use of rectangular distributions to represent systematic uncertainties; and measurable and nonmeasurable uncertainties that require estimation. The author also discusses sources of measurement errors and curve fitting with numerous examples of uncertainty case studies. Many useful tables and computational formulae are included as well. All formulations are discussed and demonstrated with the minimum of mathematical knowledge assumed. This second edition offers additional examples in each chapter, and detailed additions and alterations made to the text. New chapters consist of the general theory of uncertainty and applications to industry and a new section discusses the use of orthogonal polynomials in curve fitting. Focusing on practical problems of measurement, Uncertainty, Calibration and Probability is an invaluable reference tool for R&D laboratories in the engineering/manufacturing industries and for undergraduate and graduate students in physics, engineering, and metrology.

An Introduction to Error Analysis kassel university press GmbH

Researchers in the natural sciences are faced with problems that require a novel approach to improve the quality of forecasts of processes that are sensitive to environmental conditions. Nonlinearity of a system may significantly complicate the predictability of future states: a small variation of parameters can dramatically change the dynamics, while sensitive dependence of the initial state may severely limit the predictability horizon. Uncertainties also play a role. This volume addresses such problems by using tools from chaos theory and systems theory, adapted for the analysis of problems in the environmental sciences. Sensitive dependence on the initial state (chaos) and the parameters are analyzed using methods such as Lyapunov exponents and Monte Carlo simulation. Uncertainty in the structure and the values of parameters of a model is studied in relation to processes that depend on the environmental conditions. These methods also apply to biology and economics. For research workers at universities and (semi)governmental institutes for the environment, agriculture, ecology, meteorology and water management, and theoretical economists.

Data and Error Analysis University of Birmingham Computer Centre

Within the scope of the Accelerator Driven System (ADS) concept for nuclear waste management applications, the burnup uncertainty estimates due to uncertainty in the activation cross sections (XSs) are important regarding both the safety and the efficiency of the waste burning process. We have applied both sensitivity analysis and Monte Carlo methodology to actinides burnup calculations in a lead-bismuth cooled subcritical ADS. The sensitivity analysis is used to identify the reaction XSs and the dominant chains that contribute most significantly to the uncertainty. The Monte Carlo methodology gives the burnup uncertainty estimates due to the synergetic/global effect of the complete set of XS uncertainties. These uncertainty estimates are valuable to assess the need of any experimental or systematic reevaluation of some uncertainty XSs for ADS.

Decision Making under Uncertainty Routledge

In the courtroom, critical and life-changing decisions are made based on quantitative forensic science data. There is often a range in which a measured value is expected to fall and, in this, an inherent uncertainty associated with such measurement. Uncertainty in this context is not error. In fact, estimations of uncertainty can add to the utility and reliability of quantitative results, be it the length of a firearm barrel, the weight of a drug sample, or the concentration of ethanol in blood. Measurement Uncertainty in Forensic Science: A Practical Guide describes and defines the concepts related to such uncertainty in the forensic context. The book provides the necessary conceptual background and framework—a baseline—for developing and deploying reasonable and defensible uncertainty estimations across forensic disciplines. Information is presented conceptually, using easily understood examples, to provide a readable, handy reference for scientists in the laboratory, as well as investigators and legal professionals who require a basic understanding of the science underpinning measurement results.

Measurement Uncertainty in Chemical Analysis DIANE Publishing

Quantifying uncertainty and error bounds is a key outstanding challenge in ocean state estimation and climate research. It is particularly difficult due to the large dimensionality of this nonlinear estimation problem and the number of uncertain variables involved. The "Estimating the Circulation and Climate of the Oceans" (ECCO) consortium has developed a scalable system for dynamically consistent estimation of global time-evolving ocean state by optimal combination of ocean general circulation model (GCM) with diverse ocean observations. The estimation system is based on the "adjoint method" solution of an unconstrained least-squares optimization problem formulated with the method of Lagrange multipliers for fitting the dynamical ocean model to observations. The dynamical consistency requirement of ocean state estimation necessitates this approach over sequential data assimilation and reanalysis smoothing techniques. In addition, it is computationally advantageous because calculation and storage of large covariance matrices is not required. However, this is also a drawback of the adjoint method, which lacks a native formalism for error propagation and quantification of assimilated uncertainty. The objective of this dissertation is to resolve that limitation by developing a feasible computational methodology for uncertainty analysis in dynamically consistent state estimation, applicable to the large dimensionality of global ocean models. Hessian (second derivative-based) methodology is developed for Uncertainty Quantification (UQ) in large-scale ocean state estimation, extending the gradient-based adjoint method to employ the second order geometry information of the model-data misfit function in a high-dimensional control space. Large error covariance matrices are evaluated by inverting the Hessian matrix with the developed scalable matrix-free numerical linear algebra algorithms. Hessian-vector product and Jacobian derivative codes of the MIT general circulation model (MITgcm) are generated by means of algorithmic differentiation (AD). Computational complexity of the Hessian code is reduced by tangent linear differentiation of the adjoint code, which preserves the speedup of adjoint checkpointing schemes in the second derivative calculation. A Lanczos algorithm is applied for extracting the leading rank eigenvectors and eigenvalues of the Hessian matrix. The eigenvectors represent the constrained uncertainty patterns. The inverse eigenvalues are the corresponding uncertainties. The dimensionality of UQ calculations is reduced by eliminating the uncertainty null-space unconstrained by the supplied observations. Inverse and forward uncertainty propagation schemes are designed for assimilating observation and control variable uncertainties, and for projecting these uncertainties onto oceanographic target quantities. Two versions of these schemes are developed: one evaluates reduction of prior uncertainties, while another does not require prior assumptions. The analysis of uncertainty propagation in the ocean model is time-resolving. It captures the dynamics of uncertainty evolution and reveals transient and stationary uncertainty regimes. The system is applied to quantifying uncertainties of Antarctic Circumpolar Current (ACC) transport in a global barotropic configuration of the MITgcm. The model is constrained by synthetic observations of sea surface height and velocities. The control space consists of two-dimensional maps of initial and boundary conditions and model parameters. The size of the Hessian matrix is 0(1010) elements, which would require 0(60GB) of uncompressed storage. It is demonstrated how the choice of observations and their geographic coverage determines the reduction in uncertainties of the estimated transport. The system also yields information on how well the control fields are constrained by the observations. The effects of controls uncertainty reduction due to decrease of diagonal covariance terms are compared to dynamical coupling of controls through off-diagonal covariance terms. The correlations of controls introduced by observation uncertainty assimilation are found to dominate the reduction of uncertainty of transport. An idealized analytical model of ACC guides a detailed time-resolving understanding of uncertainty dynamics. Keywords: Adjoint model uncertainty, sensitivity, posterior error reduction, reduced rank Hessian matrix, Automatic Differentiation, ocean state estimation, barotropic model, Drake Passage transport.

How to Measure Anything CRC Press

It is now becoming recognized in the measurement community that it is as important to communicate the uncertainty related to a specific measurement as it is to report the measurement itself. Without knowing the uncertainty, it is impossible for the users of the result to know what confidence can be placed in it; it is also impossible to assess the comparability of different measurements of the same parameter. This volume collects 20 outstanding papers on the topic, mostly published from 1999-2002 in the journal "Accreditation and Quality Assurance." They provide the rationale for why it is important to evaluate and report the uncertainty of a result in a consistent manner. They also describe the concept of uncertainty, the methodology for evaluating uncertainty, and the advantages of using suitable reference materials. Finally, the benefits to both the analytical laboratory and the user of the results are considered.

Estimation of Uncertainty for Contour Method Residual Stress Measurements Springer Science & Business Media

Analytical chemical results touch everyones lives can we eat the food? do I have a disease? did the defendant leave his DNA at the crime scene? should I invest in that gold mine? When a chemist measures something how do we know that the result is appropriate? What is fit for purpose in the context of analytical chemistry? Many manufacturing and service companies have embraced traditional statistical approaches to quality assurance, and these have been adopted by analytical chemistry laboratories. However the right chemical answer is never known, so there is not a direct parallel with the manufacture of ball bearings which can be measured and assessed. The customer of the analytical services relies on the quality assurance and quality control procedures adopted by the laboratory. It is the totality of the QA effort, perhaps first brought together in this text, that gives the customer confidence in the result. QA in the Analytical Chemistry Laboratory takes the reader through all aspects of QA, from the statistical basics and quality control tools to becoming accredited to international standards. The latest understanding of concepts such as measurement uncertainty and metrological traceability are explained for a working chemist or her client. How to design experiments to optimize an analytical process is included, together with the necessary statistics to analyze the results. All numerical manipulation and examples are given as Microsoft Excel spreadsheets that can be implemented on any personal computer. Different kinds of interlaboratory studies are explained, and how a laboratory is judged in proficiency testing schemes is described. Accreditation to ISO 17025 or OECD GLP is nearly obligatory for laboratories of any pretension to quality. Here the reader will find an introduction to the requirements and philosophy of accreditation. Whether completing a degree course in chemistry or working in a busy analytical laboratory, this book

is a single source for an introduction into quality assurance.
Quantifying Uncertainty in Analytical Measurement CRC Press
This document describes the statistical methods used to determine sample-based uncertainty estimates for the Best Basis Inventory (BBI). For each waste phase, the equation for the inventory of an analyte in a tank is Inventory (Kg or Ci) = Concentration x Density x Waste Volume. the total inventory is the sum of the inventories in the different waste phases. Using tanks sample data: statistical methods are used to obtain estimates of the mean concentration of an analyte the density of the waste, and their standard deviations. The volumes of waste in the different phases, and their standard deviations, are estimated based on other types of data. The three estimates are multiplied to obtain the inventory estimate. The standard deviations are combined to obtain a standard deviation of the inventory. The uncertainty estimate for the Best Basis Inventory (BBI) is the approximate 95% confidence interval on the inventory.
Measurement Uncertainty in Chemical Analysis Supreet Singh Bahga
Ever increasing demands for improved performance, reliability, and productivity in today's manufacturing industry have resulted in a need for tighter geometric tolerances and the ability to measure these tolerances quickly and reliably. Coordinate measuring machines (CMMs) have become an important tool in measuring geometric tolerances, but as tolerances tighten, determining measurement uncertainty becomes an important issue. This issue is widespread and has gained international focus in the metrology industry. As a result, some commercial software products, which use different methodologies, have been developed that claim to estimate task specific measurement uncertainty. However, the reliability of these estimates has not been adequately examined. The objective of this study is to add to the body of knowledge geared toward validating these methods by comparing three different methods of determining measurement uncertainty. The three methods that were compared are: 1) a simulation method developed for this study that uses a hole-plate artifact, 2) PUNDIT, a commercial software package developed by Metro Sage, and 3) a comparator method involving actual measurements on CMMs. This study looks only at measurements in a two dimensional plane and the experimental studies are conducted using several different CMMs.