



**Association for Coordinate Metrology Canada**  
**Association canadienne de métrologie de coordonnées**

# NEWS 2000

[www.acmc-canada.ca](http://www.acmc-canada.ca)

*Dear ACMC members,*

*The 1999 ACMC Annual General Meeting (AGM) held in London, Ontario was a great success with an attendance of 62 participants from the coordinate metrology community. Eleven excellent presentations by experts from academia, industry, and government research institutes covered topics of practical interest and explored broader issues related to measurement science. As a bonus, participants were treated to a tour of the facilities at NRC's Integrated Manufacturing Technologies Institute—laboratories for contact and laser metrology, rapid prototyping, laser machining, and the latest technologies in 3D visualisation including a virtual reality immersion room.*

*Since our 1999 AGM in July, the ACMC has taken steps to enhance communications with its target community. A totally new website has been constructed at [www.acmc-canada.ca](http://www.acmc-canada.ca). The new site contains basic information about ACMC activities as well as copies of previous Newsletters. It also provides links to useful websites in the field of coordinate metrology. The site is interactive and visitors can register for the 8-9 June 2000 ACMC Annual General Meeting simply by printing, filling in, and mailing the form found on the site with a remittance of fees. Please contact us and suggest ways in which we can improve the site and make it effective for you!*

*I would like to warmly invite you to the AGM 2000, our much praised annual event. Our host will be Niagara College in Niagara-on-the-Lake, Ontario, Canada. The college has programs in both manufacturing and quality engineering. Coordinate metrologists work in a rapidly changing environment and the AGM is geared to helping keep our colleagues in-the-know. As you will see from the enclosed agenda, all those involved in coordinate metrology, from shop floor personnel to draftsman and engineers, and managers of CMM facilities, will benefit from attending. Our presentations will help you keep abreast of new developments and trends for your own personal development and for the benefit of your organisation.*

*I look forward to meeting you in June.*

*René Mayer, ing PhD.*  
*ACMC Chairman*

## Annual General Meeting 2000

"ACMC's annual conference, in my opinion, is one of the two or three best North American conferences on measurement issues and CMM research and use. It ranks up there with the conference that Ed Pritchard and friends have started through ORMC, the ASPE conferences, and perhaps the GIDEP conferences here in the states as one of the great learning experiences." *Richard Jennings, Mimetek LLC—<http://www.mimetek.com>*

### Where

**Niagara College**  
Niagara-on-the-Lake, Ontario

### When

**8-9 June 2000**

### Agenda

**see Agenda page 5-6**

### Registration

**see Registration page 4**

### Cost

\$185 for ACMC members  
\$235 for non-members  
\$110 for students

### Questions?

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# AGM 2000—Technical Presentations

## **Uncertainty of Measurements, Terms, Definitions and Practical Examples**, Dr. Jennifer Decker, National Research Council Canada

Primary features for uncertainty evaluation following the guidelines of the ISO Guide to the Expression of Uncertainty in Measurement (GUM) are outlined. Real-world examples from the uncertainty evaluation of gauge block calibration by mechanical comparison demonstrate these principles.

## **Using Knowledge to Reduce Dimensional Measurement Uncertainty**, Richard Jennings, Mimetek LLC, USA

How much of the “uncertainty” in dimensional Measurement Uncertainty of Coordinate Measuring Machines (CMMs) is contributed by the lack of user training and certification? How much by our imperfect knowledge of the ability of CMM software to accurately inspect and report on imperfect parts? How are CMMs and their human controllers assessed and evaluated today? Are there tests and standards for measuring CMMs and their users in realistic manufacturing and inspection environments? Do we need more robust methods and standards?

## **The Best Algorithms for Practical CMM Measurements**, Jim Salisbury, Mitutoyo America Corporation

There has been much discussion in tolerancing and metrology circles about the theoretical differences between the design intent of tolerancing standards and the popular least squares algorithms used by most CMMs. In this presentation, the practical side of algorithm selection is explored from a measurement uncertainty point of view. Assuming that no measurement process is perfect, the goal of this presentation is to show how the best algorithm might not always be the one that most closely matches the theoretical design intent but rather is the one that results in the lowest uncertainty relative to the design tolerances. With more and more CMMs being sold with a variety of available algorithms, understanding the material in this

presentation is crucial for enabling users to make the best decisions and the most accurate measurement with their CMMs.

## **CMM Calibration and Traceability Issues** Dr. Steve Phillips, NIST, USA

There is considerable debate regarding the concept of CMM calibration. Currently proposed methodology ranges from performance evaluation (B89.4.1, VDI/VDE 2617), to virtual CMMs, to a substitution method using a master artifact. This talk addresses all these methods related to a CMM calibration, and also how CMM calibration results can be used to evaluate measurement uncertainties statements on work pieces, hence establishing measuring traceability.

## **High Accuracy Artifact for the Evaluation of Large CMMs**, Dr. Steve Phillips, NIST, USA

A high accuracy artifact useful for the evaluation of large CMMs will be presented. This artifact can be physically probed by the CMM in contrast to conventional techniques that use purely optical methods such as laser interferometers. The system can be used over large distances, e.g. over four meters, with an uncertainty of less than one part per million. The artifact is relatively inexpensive, robust for use in reasonable industrial environments, and significantly reduces testing time over traditional step gauge measurements.

## **Curve Detection on Sculptured Surfaces**, Dr. Allan Spence, McMaster University, Canada

The ability to extract curves from sculptured surfaces has applications ranging from hand made model digitizing and reverse engineering, to strain measurement for metal stamping and plastic thermoforming. This presentation will describe the use of a laser digitizer to detect curves that are drawn on sculptured surfaces, and convert the information into a B-spline surface and curves CAD model. Several example parts will be shown, along with the resulting CAD models.

# AGM 2000 Presentations

## **Statistical Process Control, Sampling and CMM**, Tony Deviveiros, General Motors of Canada

Statistical Process Control is a powerful tool to monitor the performance of an industrial manufacturing process. Most likely SPC is achieved by the use of control charts. These in turn require sampling plans. The sampling plan is by far the most important element of setting up a control chart. The sampling plan includes the sample size and the rational sub-grouping of the process data. When the sample size and the rational sub-grouping are based on the CMM availability schedule it will more likely miss the whole purpose of SPC.



## **Results of the CIRP Form comparison 1996-1998**, Jim Salsbury, Mitutoyo America Corporation

The International Institution for Production Engineering Research (CIRP) conducted an international comparison for form measurement during 1996 to 1998. The comparison primarily focused on the measurement of roundness but also included straightness and parallelism of cylindrical workpieces. Twenty-two international institutions participated in the study, and the instruments used for the measurements ranged from various spindle based form testers to coordinate measuring machines (CMMs). Of particular interest in this study was that the artifacts had significant form deviations of various shapes. The participants were asked to report measurement results and also their estimated measurement uncertainty. In this presentation, some of the results of the comparison are presented and discussed. In addition, the results are analyzed relative to closeness in agreement, capability to estimate measurement uncertainty, and the use of CMMs for measuring form.



## **GR&R Studies on CMM Accuracy**, Richard Knebel, Carl Zeiss IMP Corp.

This paper will discuss the basic terms of accuracy, repeatability, and reproducibility. Further, it will review a common GR&R procedure, define 10% GR&R in some different terms, explore sources of error, and provide some tips to help you achieve acceptable Gage R&Rs on CMMs.



# CMM Operator Certification Update

Members of the ACMC Steering Committee, under the leadership of Prof. Stelian George-Cosh of Conestoga College, continue to plan, research, compile and write the documentation required for the Canadian implementation of the "Certification of CMM Operators".

Prof. George-Cosh will report on the progress of the project at the June meeting. Headway has been made in the Body of Knowledge. This document will guide the design of training and education for CMM operators, and provide the base criteria for examination questions.

1. Technical mathematics
2. Technical drawings
3. Applied statistics for manufacturing ✓
4. Measurement instruments (other than CMMs)
5. CMM hardware
6. CMM software
7. Measuring errors and uncertainty ✓
8. Machine capability
9. CMM operations
10. Standards and specifications, user groups and associations, certification bodies ✓

The estimation of measuring uncertainties and their application during part acceptance will become a very important part of the CMM operator's work. Four presentations on the subject and nature of measurement uncertainties are on the agenda for the AGM 2000.

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