



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

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**2004 ACMC Annual Workshop**  
Integrated Manufacturing Technologies Institute  
London Ontario  
17-18 June 2004

**Thursday, 17 June 2004**

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- 08:30 - 08:50      **CONFERENCE REGISTRATION**  
Coffee & breakfast refreshments
- 08:50 - 09:00      **Welcoming Remarks**  
Kostadin Doytchinov, ACMC Chairman  
Dr. Gian Vascotto, Research Director of Systems Simulation and Control  
NRC-Integrated Manufacturing Technologies Institute
- 09:00 - 10:30      **GD&T from a Measurement and Design for Manufacturability**  
Dr. Greg Hetland, International Institute of Geometric Dimensioning and Tolerancing  
  
Abstract: The current and growing state of technology advances in the mechanical and electro-mechanical engineering arenas require higher precision in the interpretation and advanced applications of Geometric Dimensioning and Tolerancing (GD&T). Key drivers influencing this need include: product and feature miniaturization, tolerance truncation, advanced product and equipment reliability, and utilization of measurement uncertainty analysis. The critical engineering language, GD&T, is the "foundational language" required to achieve optimal "design / functional intent" at the least amount of overall cost. This presentation focuses on "GD&T from a Measurement and Design for Manufacturability Perspective," with emphasis on common design and measurement applications which result in significant ambiguities and uncertainties that can have a direct negative impact on product and equipment conformance to design requirements. Recommendations will be made to aid in higher precision in design definition, product manufacturability, physical measurement and overall product reliability
- 10:30 - 10:45      **COFFEE BREAK**
- 10:45 - 11:45      **New Technology for 3D Inspection and Reverse Engineering**  
Richard Smeenk, Charles Mony, Agile Manufacturing  
  
Presentation Overview
- Integrated Touch Probe and Laser Scanning Hybrid system: allows both inspection applications and reverse engineering applications.
  - Technical presentation: scanning process and technology, on-camera Renishaw PH 10 interface; utilization, benefits, considerations, accuracy
  - Comparison of methods: contact versus non-contact measurement
  - Technical specifications and data capture capabilities of the system
  - Interfaces: CMM, measurement arms, CNC, robots
  - 3D Laser Inspection: rapid & accurate, non-deforming, on-line and off-line programming, quality management and reporting
  - Virtual CMM using Point Clouds

- Best fit and colorimetry
- Flush and gap analysis
- Feature measurement
- Applications: mould, tool & die, prototypes, plastic & composite parts, casting and stamping parts. Usage in QC environment & in plant.
- Examples: tooling inspection and digitizing—mold or pattern modification, storage of 3D model of existing tool, inspection and certification, scanning for machining of replacement tooling.
- Application software for inspection: from part to 3D inspection based on CAD data
- Laser Scan, Point Cloud and STL treatment
- Comparison and measurement
- Inspection reporting
- Reverse Engineering: Point Cloud capture, data conversion, automatic NURBS surface creation or .stl file creation, process for creating Class A surfaces and parametric models. Also used for virtual reality, E Learning, rendering, animation, simulation, virtual prototyping.

11:45 - 12:15

### **The Metrology Wars: CMM Terrorist Group Emerges**

Hillard Cox, Frank J. Cox Ltd.

Battles over dimensional measurements have been with us from the days of the cubit and despite improved technology, not much has changed in practical terms since then, with the possible exception of the amount of paper consumed. From the shop floor to the calibration laboratory, massacres of the micron continue to occur.

The usual combatants are present at every battle but more recently, a new terrorist group known as CMM has emerged. The Battle At Bent Ram provided a set-back for them but they are threatening to reappear in a new form. Instead of hand-to-hand combat, the anticipated threat is from scanning death rays.

Fresh from the trenches, your intrepid war correspondent delivers the details from the scenes of battle. In the interests of security for the faint of heart, he will refrain from showing graphic images from the front in the form of overheads or mind-numbing statistics.

12:15 - 13:15

### **LUNCH**

13:15 - 14:15

### **The “metrics” of the ISO quality management models**

Maurice Lake

This presentation will show:

- Results of surveys conducted by independent sources and the author.
- Actual and potential gains made by organizations implementing the ISO and other management models.
- Practical experiences of small and medium sized Canadian enterprises that demonstrate the level of sophistication and motivation regarding the use of metrics in managing their businesses.

14:15 - 15:15

### **Some cost effective probing solutions for more accuracy in less time**

David Wright, formerly of Renishaw and Ferranti, U.K.

Presentation overview:

Scanning

- Why scan?
- Sample results
- Known and unknown profiles

- Digitising (surprises expected) versus scanning (surprises not expected)
- Filtering
- Cheating on the ISO 10360-4 test
- Touch Trigger versus Analogue/Digital probes life and lobing
- Cost/performance of analogue versus digital probes
- Mapping out analogue probe errors
- CMM response/probe dynamics/probe damping
- Quarantining data
- System dynamic error mapping and correction

This presentation will be continued after the coffee break.

15:15 - 15:30

### COFFEE BREAK

15:30 - 16:00

### Some cost effective probing solutions for more accuracy in less time

David Wright, formally of Renishaw and Ferranti, U.K

Analogue probes

- Active head overview
- Design starts at the probe tip and works backwards. Probe specification was simply minimal mass and size, with maximum bandwidth and accuracy, but the theoretical ideal of non-contact optical has practical problems. However, a contacting optical sensor has achieved these requirements.
- System performance
- Outline probe design

16:00 - 16:45

### Traceable In-line Metrology for Car Body Manufacture

Frank Mönning, Chair of Metrology and Quality Management, Laboratory for Machine Tools and Production Engineering (WZL) of the RWTH, Aachen, Germany

Abstract: In car body manufacturing optical Inline Measurement systems are applied more and more commonly. Depending on the application fixed mounted sensors, flexible robot mounted sensors or hybrid systems are used. In this session a new concept of estimating the measurement uncertainty of Inline-Systems will be presented. This approach includes the possibility of using the CMM as a reference for calibrating the Inline-System.

The presented results have been elaborated by the INTRAC working group consisting of car manufacturers, measurement system suppliers and research facilities.

16:45 - 17:15

### ACMC Business

Annual Report and Election of Officers

17:15 - 17:45

### Open Discussions and Vendor's Time

18:30 - 18:45

### RECEPTION (Cash Bar)

Michael's on the Thames

18:45

### DINNER

Michael's on the Thames

Friday, 18 June 2004

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08:00 - 08:30

**CONFERENCE REGISTRATION**

Coffee & breakfast refreshments

08:30 - 10:00

**Uncertainty in Laser Probing on CMMs**

Tom Charlton, Member of ISO committee

Three major probe types are found in widespread use today on CMMs: touch probes, video probes and laser probes. In the case of multi-sensor machines, all three types may be used concurrently. Although laser probes offer some unique measurement advantages, of the three probe types, the laser probes have had the least work done on characterization their performance characteristics and measurement uncertainty contributors.

In the current work we present a mix of tutorial background information, theoretical analysis, practical test methods, and experimental results. The measurement behavior of laser probes is examined both for single point probing and as active scanning sensors. We examine such probe characteristics as effective spot size, lateral resolution and registration, speed dependencies, laser intensity effects and repeatability. In addition we also will address perhaps the most difficult issue in using optical probes, the influence of workpiece material properties such as surface inclination, finish and reflectivity. Direct comparisons of laser results to touch probes results will be presented in some cases.

As a result of our extensive testing, some practical guidance is developed and presented for assessing the performance of laser probing for potential measurement applications. We conclude with some preliminary estimates of the uncertainty contributors of laser probing to workpiece measurement uncertainty.

10:00 - 10:15

**COFFEE BREAK**

10:15 - 11:15

**Future trends in coordinate metrology**

Dr. Graham Peggs, National Physics Laboratory (NPL) United Kingdom

This presentation will look at the evolution and revolution of very large and very small coordinate measuring instruments.

11:15 - 12:15

Tour of IMTI laboratories

12:15 - 13:15

LUNCH

[2004 Annual Workshop concludes](#)