

SUBMITTED BY
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TRIP REPORT

TWO DEMONSTRATIONS OF METROLOGY
INTEROPERABILITY AT

QUALITY EXPO 2005
ROSEMONT, IL, USA
APRIL 19 - 21, 2005
AND

CONTROL 2005
SINSHEIM, GERMANY
APRIL 26 - 29, 2005

DEMONSTRATION SUMMARY

Two public demonstrations of interface standards for dimensional metrology systems were given at the Quality Expo 2005 in Chicago, April 19 - 21, 2005 and at the Control 2005 Show in Sinsheim, Germany April 25 – 29, 2005. The latter show is purported to be the world's largest show solely dedicated to quality control-related products. Organizations that supported the demos were the Automotive Industry Action Group (AIAG) Metrology Interoperability Project Team (MIPT), the I++ Group (BMW, Daimler Chrysler, Audi, Volkswagen, and Volvo), and the IA.CMM (a leading association of CMM manufacturers worldwide). Substantial help came from dimensional metrology system manufacturers as well as members of the NIST metrology interoperability project team (John Horst, Tom Kramer, and Bill Rippey).

The demonstrations exposed the interoperability between products of different vendors, made possible using the I++DME, and Dimensional Markup Language (DML) interface specifications. I++DME connects a CMM motion and probe system with execution software that directs inspection operations. DML carries inspection results from CMM execution software-to-software applications for part analysis and statistical process control (SPC). These two demonstrations were conducted to include more vendor participants, and to expand on the functionality demonstrated at IMTS in September 2004. These more recent demos included more of the kinds of activities required of CMMs in day-to-day operation on the factory floor, including: part alignment, scanning, touch probing, and tool changing.

NIST received encouraging news concerning the use of the NIST I++ DME test suite during these shows. For example, Etienne Rossignon said that Delcam was implementing an I++ DME compliant version of their client software product, PowerInspect. He added that **“we use the NIST I++ DME test suite and it greatly helped in our client software development.”**

Our progress toward interoperability got substantial recognition at both shows. At QE2005, the MIPT held a panel discussion attended by over 60 professionals, followed by a press conference and live demo at our booth on the show floor. The panel consisted of Bob Waite (MIPT chair), Glen Allan (MIPT co-chair), John Horst (NIST metrology interoperability project manager), and Akram Yunas (AIAG program manager). Bob Waite, John Horst, and Bill Rippey (NIST metrology interoperability testbed manager) spoke at the press conference at the booth. Two key members of the technical press attended both the panel discussion and press conference (Dirk Dusharme of Quality Magazine and Mark Hoske of Control Engineering Magazine). Control Engineering recently published an online article describing these demos. This article can be found at the following web site:

<http://www.manufacturing.net/ctl/index.asp?layout=articlectl&articleid=CA527339&nid=2365&rid=1273106922>.

Several other articles describing our work were published in the Control Express magazine (published by Quality Engineering Magazine and handed out at Control 2005). These articles described the activities at our interoperability booth and as well as a conference (held on April 28 at Control 2005) on interoperability consisting of lectures by metrology interoperability workers worldwide, including John Horst of NIST.

As a result of our work, many dimensional metrology systems vendors and users continue to unveil I++ DME compliant products that are emerging on the shop floor. John Deere has at least four I++ DME compliant systems operating on their shop floor. Renishaw continues to promote I++ compliance with its CMM controller product, the UCC controller. It was revealed at Control 2005 that Renishaw sees the I++ DME philosophy (i.e., keeping sensor details at the server-side of the interface) to be key and critical to its marketing strategy, and they backed up these words with substantive participation in both demos: offering an I++ DME-compliant UCC controller running on two different CMMs. Metrologic has announced (March 2004) that their latest version of Metrolog XG version 2 is I++ DME compliant. Zeiss announced I++ DME compliance last year for its line of computer-controlled (DCC) CMMs. Metromec has announced I++ DME support for both client and server software for their product Metrosoft CM version 3.6. Delcam's new client software for DCC CMMs is I++ DME-compliant. Zeiss' Holos software demonstrated I++ DME compliance for the first time at Control 2005. Tecnomatix (UGS) has a released version I++ DME for the product eM-Measure (eM-Inspector is a module of eM-Measure). At installation time, the user has the option to pick the I++ DME interface. Applied Automation Technologies (AAT) has announced I++ DME implementations for both client and server software products. AAT has also used the NIST I++ DME test suites to test implementations and are uniquely using server implementations to enable CMM retrofitting. The general consensus at both shows, however, was that neither the I++ DME spec nor implementations of I++ DME are ready for "prime time." As a result, industry leaders are proposing a meeting of I++ DME implementers in June 2005 in Germany to discuss what remains to be done and what the community should do to accomplish it.

DESCRIPTION OF THE DEMONSTRATIONS

The live demonstrations emphasized the utility of the I++ DME and DML interface specifications through a live execution of the same inspection routine performed using inspection software and coordinate measuring machines (CMMs) from a wide variety of manufacturers. The key benefit of these open, non-proprietary interface specifications is interoperability. By running all CMMs with any and all of the execution application software packages, interoperability was accomplished and demonstrated.

The CMM inspection routine demonstrated the following functionality using only the definitions in the I++ DME specification version 1.4.2. The demo routine first calculated an initial part alignment using manual touch probe hits. An automatic (CNC) program then 1)confirmed the initial part alignment value, 2)inspected the top plane using four line scans, and 3)inspected the center bore using one circular scan for roundness and three circular scans for cylindricity. CMM tool changing was also performed, switching between probes for touch trigger and scanning measurements. The inspection programs contained no information that was specific to a particular CMM: for each execution application one program for manual alignment, and one program for CNC inspection controlled all CMMs in the booth. In addition, CMM execution software produced DML-compliant measurement results files to a server where analysis and SPC applications could access the results and provide visitors with graphical views of inspection results.

QUALITY EXPO, ROSEMONT, IL, APRIL 19-21

CMM brands in the booth were Zeiss (Contura), Wenzel (Smart), and Xspect Solutions (X-Cite) with a Renishaw UCC controller. Xspect Solutions provided the Smart and X-Cite machines and Zeiss provided the Contura. Hexagon (PC-DMIS), LK (Studio), Metrologic Group (Metrolog XG), Metromec (Metrosoft CM), Tecnomatix (eM-Measure), and Zeiss (Calypso) provided CMM programming/execution applications. Of 18 possible connections between products (6 times 3) we successfully ran 17 of them – the issue with the remaining link was analyzed by the on-site developers and should be fixed for the next demo. LK Studio and eM-Measure exported inspection results in DML format and were imported by Tecnomatix eM-Insight and by Mitutoyo's MeasurLink. A structured-light vision system, ATOS, was supplied and demonstrated by Capture 3D, Inc. ATOS is in early stages of implementing DML, and demonstrated output of results in DML format, in a manual mode.

CONTROL, SINSHEIM, GERMANY, APRIL 26-29

The booth was sponsored by IA.CMM and participating software vendors, and featured four CMMs with six CMM execution applications. Hexagon (DEA), Trimek (with Renishaw UCC), Wenzel, and Zeiss each supplied a CMM. The CMM execution applications were from Hexagon (PC-DMIS), Metrologic Group (Metrolog XG), Metromec (Metrosoft CM), Tecnomatix (eM-Measure), and Zeiss (Calypso and Holos). With 24 possible product-to-product connections we successfully ran 21. The incompatibilities of the 3 connections were detected by the developers and judged to be minor and fixable. In all three cases much of the demo functionality was able to run. The occurrence of three connections with errors is evidence of the following: ensuring the compatibility of multiple products is a complex task, developers are still learning lessons of interpreting and implementing the specification, and some protocol issues still need further explanation and/or clarification.

VENDOR SUPPORT FOR THE DEMONSTRATIONS

Vendor support included: shipping of CMMs to the shows, CMM set up, CMM operation maintenance, disassembly, and return shipping. Several vendors had persons at the booth for the entire duration of setup and show operation. Several weeks of testing prior to the demos involved generating inspection programs and performing in-house and vendor-to-vendor testing. International support engineers came to Chicago from all over the world, including England, France, Germany, and Switzerland. Demo staff at Control in Germany came from England, Italy, France, Germany, Spain, Switzerland, and the US.

PANEL DISCUSSION AT QUALITY EXPO 2005

The AIAG MIPT held a panel discussion at QE2005 in order to present current progress worldwide on the development of open, non-proprietary languages for dimensional metrology component interfaces and to facilitate compliant, interoperable, and functional implementations of each standard.

The panel consisted of Bob Waite (MIPT chair), Glen Allan (MIPT co-chair), John Horst (NIST metrology interoperability project manager), and Akram Yunas (AIAG program manager). Over 60 metrology/quality professionals attended the meeting.

PRESS CONFERENCE AT QUALITY EXPO 2005

Prior to the QE2005 show, technical staff and public relations staff at both AIAG and NIST developed a press release announcing the release of the DML standard as well as announcing the successful demonstration of the I++ DME standard. Bob Waite, John Horst, and Bill Rippey (NIST metrology interoperability testbed manager) spoke at the press conference at the booth. Two key members of the technical press attended both the panel discussion and press conference (Dirk Dusharme of Quality Magazine and Mark Hoske of Control Engineering Magazine).

This is the text of the press release:

“The Automotive Industry Action Group (AIAG) announced today—at a proof-of-concept demonstration at the Quality Expo Conference in Rosemont, Ill.—that a common global language specification for metrology system interfaces, called dimensional markup language (DML), will be released in June. AIAG developed DML in partnership with the National Institute of Standards and Technology (NIST), a non-regulatory agency of the Department of Commerce. DML will help connect different measuring components from various systems within a plug-and-play environment.

“The DML specification is only one part of a broader AIAG effort supporting open interface standards that efficiently communicate metrology information, helping the automotive industry recover some of the time (up to six months) and the approximately \$600 million it loses annually to build and rebuild measurement programs for different systems.

“AIAG is the umbrella that the global metrology community worked under to develop this important metrology interoperability standard, and today’s demonstration showcases the success of that collaboration,” said Chuck Koehn, AIAG acting executive director.

“AIAG and NIST, working together to address a billion-dollar plus interoperability issue, demonstrate an industry-government partnership where everyone benefits,” said Hratch G. Semerjian, acting director of NIST. “In today’s global environment, it is imperative that we adopt standardized processes that enable true collaborations across continents.”

“Defined as the science of measurement, metrology is used in the automotive industry to improve dimensional integrity in vehicles. One of the most critical issues facing the industry today is the cost of integrating proprietary dimensional measurement systems. Original equipment manufacturers (OEMs) have been generally unable to require compliance to specific standards because either no standards were in place or no conformance tests existed to verify compliance to the standard.

“AIAG’s DML specification is a common method to effectively transmit inspection results information, which addresses the current void of seamless data exchange in dimensional metrology and inspection system operations. This lack of interoperability also severely limits manufacturers’ ability to effectively build and operate measurement systems and often results in extra time to reprogram dimensional measurement and inspection

systems. Companies that transfer data for dimensional metrology and inspection system operations will benefit from the use of open standards, such as DML.

“These systems typically include CAD software, inspection program planning and execution software, a coordinate measuring machine (CMM) and inspection analysis software.

“Today’s real-time demonstration showcased the robust capability of DML as well as the I++DME open standard. The I++DME standard is a development effort of the I++ Group (DaimlerChrysler, Volkswagen, BMW, Audi, and Volvo), the International Association of Coordinate Measuring Machine Manufacturers (IA.CMM), AIAG and NIST’.

“The demonstration linked proprietary hardware and software in a live execution of part inspection—using touch-trigger probing, scanning, part alignment, and tool changing—connecting Wenzel, Xspect Solutions, and Zeiss CMMs with software from LK, Metrologic, Metromec, Tecnomatix, Wilcox Associates and Zeiss. The demo also successfully transferred part geometry and feature tolerance information from these software applications to analysis software from Dimensional Control Systems, Tecnomatix and Mitutoyo.

“The DML specification was developed by the AIAG Metrology Interoperability Project Team, whose goal is to streamline the dimensional measuring function at auto manufacturers, suppliers and tooling outfits throughout the supply chain. The team includes representatives from AIAG, NIST, DaimlerChrysler Corp. and Ford Motor Co and the product vendors named above.

“NIST has supported AIAG by providing a test bed to validate DML and I++DME—an interface standard between CMMs and execution control software—with multiple CMMs, metrology software and hardware loaned to NIST by vendor partners. NIST develops and promotes measurement, standards and technology to enhance productivity, facilitate trade and improve the quality of life.

“Founded in 1982, AIAG is a globally recognized organization where OEMs and suppliers unite to address and resolve issues affecting the worldwide automotive supply chain. AIAG’s goals are to reduce cost and complexity through collaboration; improve product quality, health, safety and the environment; and optimize speed to market throughout the supply chain. Headquartered in the metro Detroit area, its more than 1,500 member companies include North American, European and Asia-Pacific OEMs and suppliers to the automotive industry. Additional information is available on the Internet at www.aiag.org.”

IA.CMM CONFERENCE AT CONTROL 2005

The IA.CMM president, Maurizio Ercole, organized a conference of speakers at Control 2005 to present progress on enabling metrology interoperability worldwide. Topics included new ISO standards, OSIS, the I++ architecture, DME interface implementation experience, and activities of the AIAG-MIPT. John Horst presented the role of NIST. The talks at this conference revealed that the I++ group has essentially the same dimensional metrology component infrastructure as does the AIAG MIPT, however, it was not made clear what their plans are for standards at those interface. John Horst communicated this to several key I++ DME committee members, and got assurance of communication and mutual cooperation.

I++ DME / DMIS HARMONIZATION AT DMIS NATIONAL STANDARDS COMMITTEE MEETING

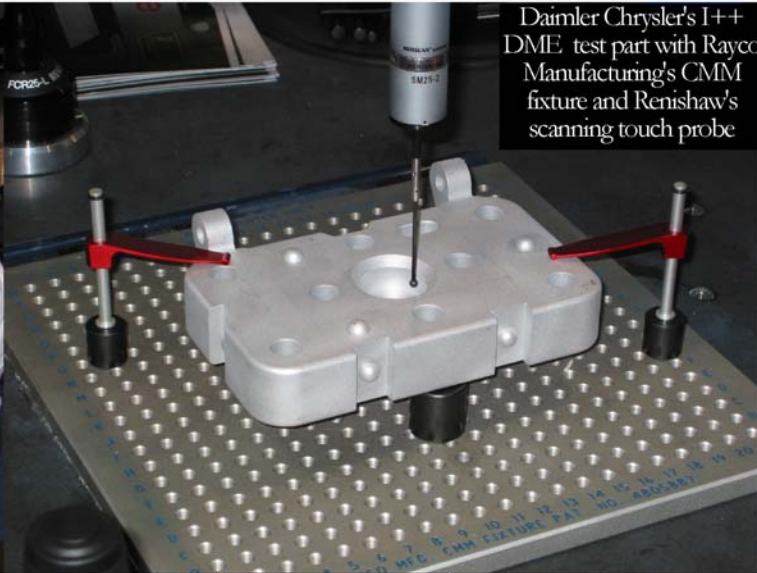
Representatives from the AIAG MIPT (John Horst of NIST, Bob Waite of Daimler Chrysler, and Glen Allan of Ford) attended the meeting of the DMIS National Standards Committee (DNSC) at Mitutoyo headquarters in Aurora IL, USA on April 20, 2005. A report was given by Lutz Karras of Zeiss on a substantive and joint effort by the I++ DME group and the European DMIS Users Group (EDUG) to harmonize DMIS and I++ DME. Those present agreed with most of the key conclusions in this report. There seems to be some consensus that releasing an I++ conformance class of DMIS would be a feasible and expedient response to the needs for harmonization between I++ DME and DMIS. There were also initial discussions on the future efforts and interactions of the DNSC, particularly with the AIAG MIPT.

PICTURES FROM QUALITY EXPO 2005 AND CONTROL 2005

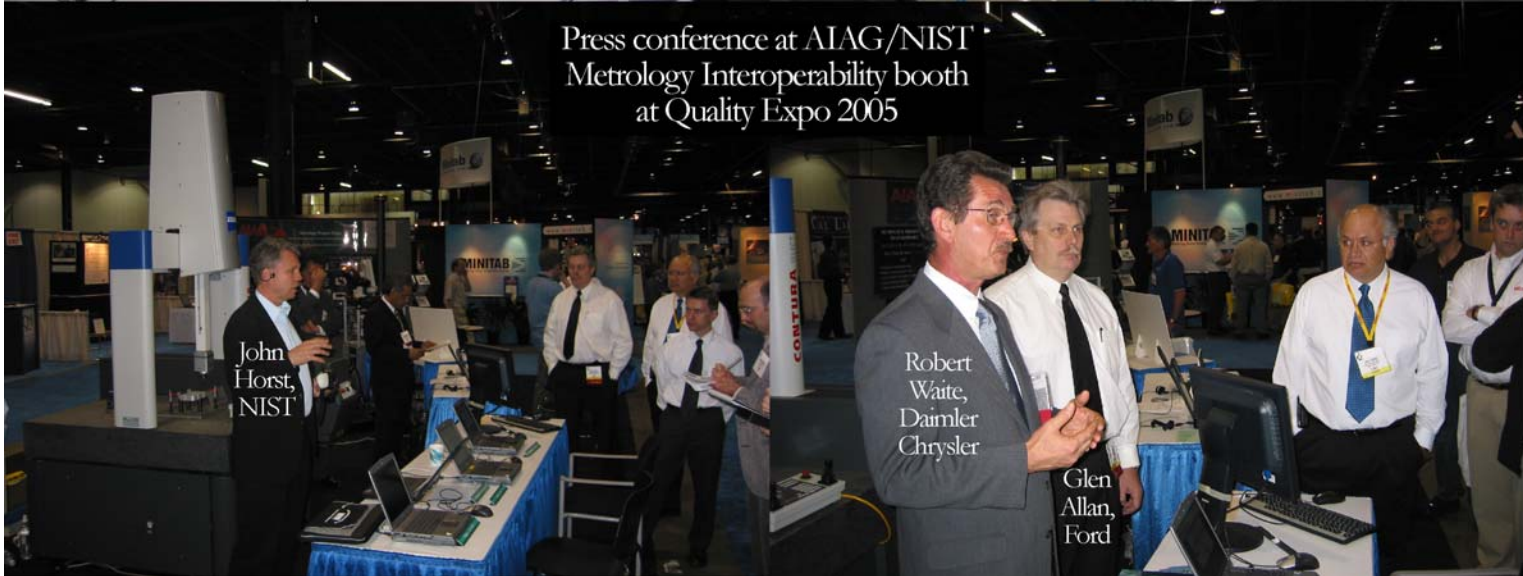
Key I++ DME client software developers,
(L to R) José Torres (Zeiss), Dave Smith
(I.K), René Keller (Metromec), and Michel
Penlae (Hexagon/Wilcox)



Daimler Chrysler's I++
DME test part with Rayco
Manufacturing's CMM
fixture and Renishaw's
scanning touch probe



Press conference at AIAG/NIST
Metrology Interoperability booth
at Quality Expo 2005



John
Horst,
NIST

Robert
Waite,
Daimler
Chrysler

Glen
Allan,
Ford

