Digital Manufacturing Advisory Group (ISO TC184/SC4 AG1) Meeting June 14 and 15, 2016

The digital manufacturing group met for two days in Troy, NY to prepare for a demonstration at the Future of Flight museum in Mukilteo, Washington on October 5th.

Advisory Group 1 (AG1)

Advisory Group 1 is a sub-committee of ISO TC184/SC4 which is developing an information model for the product life cycle. The model is commonly known as STEP, and ISO has recently released an extension that adds Geometric Dimensions and Tolerances (GD&T) to the previously defined nominal geometry and assembly data. STEP import and export interfaces exist for nearly all CAD and CAM systems.

The Digital Manufacturing Advisory Group is developing information definitions for model based manufacturing. The new model will be a collection of STEP modules and assembled as a data exchange protocol known as ISO 10303-238 Edition 2. It will make significant use of PLIB with a requirement for the definitions to be attached to a 3D model wherever possible. This includes definitions for the features, operations and tooling. The inputs include:

- ISO 10303-242 Design (including GD&T) Requirements
- ISO 10303-242 Machine Tool Kinematics
- ISO 10303-242 Additive Manufacturing
- ISO 10303-235 Materials
- ISO 13399 Cutter Tool Assembly
- ISO 14649 Machining Program
- MTConnect Machining Results
- QIF Measurement Results

Purpose of this meeting

The purpose of the meeting was to organize a demonstration to show the benefits of the new standard.

- Real time metrology.
- Automated Tool Try Out (TTO).
- Reduction in machining costs of 15% or better.

The benefits are enabled because model based machining can be monitored in real time by a machining simulator. If the simulator is running in real time then it can send a 3D model of the machining results to a virtual CMM for measurement. It can predict future results to prevent TTO errors, and it can compute the contact area between the cutter and workpiece to reduce tool wear and optimize chip thickness by dynamically adjusting feeds.

Many machining simulators exist but they are currently used offline to predict results in a CAM. The standard makes it possible for the simulator to be installed on or near the machine tool. A standard is necessary so that the model data can be delivered from many different sources, and shown on many different devices.

Meeting Summary

The following outcomes from the meeting may be of interest.

- There will be two demonstrations. A real time machining demonstration in the aft room of the museum, and an offline CMM demonstration in the basement.
- The real time machining demonstration will feature a video feed and an MTConnect feed. The MTConnect feed will be used to drive the machining simulator for viewing on two screens, and on the smart phones and tablets of the attendees.
- The CMM demonstration will measure a previously machined part and confirm the dimensions measured by the virtual CMM in the aft room.
- The 15% process savings will be demonstrated by showing how much the feed can be optimized based on the current cutter cross-section computed by the simulator.
- The TTO benefits will be demonstrated by attempting to load a tool that is too small, and by loading bad coordinates for the initial workpiece setup.
- The real time measurement will use Mitutoyo metrology software to measure virtual models of both the as-planned part and the as-machined part.
- GD&T conformance issues detected by the metrology software will be traced back to the responsible machining operation using software developed by ITI.
- NC Generation software developed by Penn State University will be used to make the machining solutions.
- The CAD.js system developed by Vanderbilt University will be used to view the machining results on tablets and smart phones..
- An ACIS translator developed by ITI will be used to enable the Mitutoyo metrology.
- The test part will be machined on an Okuma MCV4020 at the Boeing Renton plant with an MTConnect feed developed by SystemInsights.

Acknowledgements

The demonstration is made possible by the Digital Design and Manufacturing Innovation Institute (DMDII) in two projects known as “Mind the Gap” (14-02-02) and “O3” (14-06-05).

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Meeting Attendees

Sid Venkatesh, Boeing
Rich Morihara, Boeing
Ben Kassel, US Navy
John Snyder, US Army
Bengt Olsson, Sandvik
Larry Maggiano, Mitutoyo
Asa Trainer, ITI
Will Sobel, System Insights
Graham Hemingway, Vanderbilt
Daniel Finke, Penn State University
Caleb Severn, Penn State University
David Loffredo, STEP Tools, Inc.
Joe Fritz, STEP Tools, Inc.
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And the STEP Tools interns: Ian Chamberlin, Kathryn Lovell, Nicholas Fay, Robert Caneiro, William Rigby-Hall, Stephen Beale and Patrick Hesselbach