



Targeting Manufacturing Technology

Confused on safety and machinery control systems? Take this survey

Machinery controls have evolved from simple hard wired circuits to evermore complex hardware and software systems. Whenever machinery controls are used to reduce risk, they become what is known as "safety related parts of the control system" and the system reliability must be properly assessed. Determining just how reliable a safety circuit or system is demands a comprehensive approach. As safety PLCs replace relays, mechatronic actuators drive hazardous motion and software driven safety features like "safe speed" and "safe position" become prevalent, analyzing safety system reliability becomes a complex task indeed. When control systems fail to perform as expected, machines can move unexpectedly or not stop when expected - this can result in injuries to personnel or damage to equipment or products. The more complex the system(s), the greater the difficulty in identifying and preventing unintended consequences.



Paul Warndorf
V.P. - Manufacturing Technology

The standards writing community has tried to keep pace with the technological advances, and we have seen the now familiar "Category" system from EN 954-1(1996) evolve into the much debated ISO 13849-1 (2006) and IEC 62061 (2005). Adding to the confusion, the term "control reliability" has been used in the U.S. for several years but there has been confusion as to exactly what the term means.

In 2006, the latest revision of ISO 13849-1 introduced a probabilistic determination of potential control system failures. The 2006 standard intended to replace the categories of the 1999 version with newer "Performance Levels" as the metric used to discuss control systems. Yet a third methodology appears in IEC 62061 which uses "Safety Integrity Levels" (SILs), and applies only to electronic systems and tends to be used frequently in the processing industries.

In 2011, ISO Technical Committee 199 (responsible for the ISO 13849 standard) and IEC Technical Committee 44 (responsible for the IEC 62061 standard) formed a Joint Working Group (JWG) of ISO and IEC "experts" to evaluate developing a new standard for safety related control systems. One suggestion being considered is merging the contents of ISO 13849-1 and IEC 62061 to include the methods of PLs and/or SILs (one, the other, or both). Another suggestion is to create a yet another new method different from PLs and SILs to be used for control systems.

Such proposed changes can have significant impacts to the engineering development and use of machinery builders and end users. In an attempt to try to assess that impact, the JWG has developed a brief survey requesting that machinery builders and end users of machinery share their views on this topic. This is time-sensitive as the survey will close by end of August to allow the results to be compiled for discussion at a meeting scheduled for this September. This is your opportunity to impact the standards development work - let your voice be heard!

The survey can be obtained at <http://bit.ly/ISOquestionnaire>. For additional information or any questions, please contact Bruce Main (an ISO/TC 199 member of the JWG) at bruce@designsafe.com.

SAE holds international training event

SAE International held their Section Officer Leadership Seminar (SOLS) North American training conference this past month. SOLS brings volunteers from SAE International North American sections representing manufacturing, engineering, academia and workforce development together to hear from peers and colleagues about best practices to support more effective SAE sections. The members of these sections support regional, local Mobility Engineering industries in Aerospace, Automotive and Commercial Vehicles.

SOLS provided four main sessions. AMT's Tim Shinbara led teams that provided content for two of the sessions: engaging membership (providing the value proposition to members and industry); and improving communications (applying the right message, at the right time, to the right audience). *If anyone is interested in learning more about the SOLS conference, please contact Tim at 703-827-5243.*

Future B11 Standards meeting

B11 ASC - July 23-24, 2012 - Seattle, Wash.

If you have an interest in participating in this meeting or would like more information, contact David Felinski at dfelinski@B11standards.org.

Tech Time...

The manufacturing sweet spot: moving from intuition to simulation

By Tim Shinbara
Technical Director

This month we take a break from disruptive hardware technologies to provide insight on some of the advancements realized in traditional manufacturing by leveraging machining dynamics data and raising visibility to its role in supporting optimal machining.

You have your machine, your tool, tool holder and a machinist handbook for all necessary feeds and speeds to make the best part you can ... you must be set, right? Not so fast! It may not take a great leap of faith to agree that not everything in a machinist book is absolute truth, but what you may not know is where you can find such data to lead one down that elusive path of optimized part production.

This month I had the opportunity to follow up with Dr. Tony Schmitz (Associate Professor, University of North Carolina at Charlotte, and co-author with Dr. Scott Smith of the book "Machining Dynamics") and Mr. Dave Barton (co-founder of BlueSwarf) from an initial meeting at the 2012 National Center for Defense Manufacturing and Machining (NCDMM) Summit. We had an interesting discussion on technology gaps in traditional machining, as well as how value is added to production by knowing how to find that manufacturing "sweet spot" of optimal material removal rate (MRR).

Traditionally, master machinists used their fine-tuned ears and years of experience to "listen" for the right tone produced by a particular setup (feeds, speeds, tool length, etc.) in a particular material to establish the best parameters for that operation on that machine. This process, though effective, is not efficient, transferrable or scalable with the multitude of new materials and processes in the market today. This process is also not without its challenges, the least of which is the drastic reduction in the available

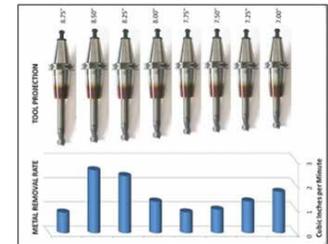
skill set like that of a master machinist. This dependence upon a person's intuition and conservative paper-based calculations has created the "last gap in technology and automation in CNC machining" as stated by Schmitz and Barton. This gap could be filled with a science-based approach to identifying speeds, feeds and depths of cuts; then providing such data via an interactive dashboard.

Their approach takes the current state-of-the-art tap testing, where the dynamic response of each tool in each machine is measured, to the next level by predicting the tool point dynamics from just one spindle measurement and tool-holder model. This data can subsequently be used to calculate the milling process stability.

Once the input data including the tool and holder geometry and spindle response are known, then the elements are combined that are convenient to model (tool and tool holder) to the measurements of those that are inconvenient to model (the spindle-machine subassembly). The procedure for combining these two elements is known as Receptance Coupling Substructure Analysis (RCSA).

The benefit of using RCSA capabilities to replace the tap test is that now any machine's response can be initially based using a simple artifact and then simulations will provide, with significantly high confidence, a profile of feeds and speeds that correspond to given material removal rates for other selected tool-holder combinations. What is interesting, counter-intuitive in fact, is that if one were to encounter chatter and vibration at a given set of parameters, the knee-jerk reaction would be to decrease tool length or begin changing spindle and feed rates. While these typical approaches can provide an acceptable solution in general, it does not necessarily

Tool Projection with Resulting MRR



provide an optimum one. Many studies have been completed to demonstrate that higher MRR can often be achieved if the tool point dynamics are known (see figure above). The secret lies in finding the combination that matches the Tooth Passing Frequency (the number of tooth impacts per 1 second; in Hertz) with the dominant natural frequency from the Tool Point Frequency Response (a natural frequency is a frequency at which the system "wants" to vibrate; in Hertz). This harmony is the "sweet spot" in machining and also what maximizes productivity (optimal system solution for chip removal, tool life and part quality). As shown in the figure, by changing the tool length, the dynamic response of the tool-holder-spindle-machine assembly can be tuned to enable higher MRR to be achieved when identifying the sweet spot for each tool overhang length.

The point is made that only listening and depending upon tribal knowledge proves less efficient and, in a time where those types of resources are dwindling, there is another physics-based path to optimal machining that may even begin attracting much of the younger talent to manufacturing. Many thanks to Tony and Dave for their time spent with me and I look forward to more great work from Blueswarf and Tony's research at UNCC.

For more information about this series contact me at tshinbara@AMTonline.org or by phone at 703-827-5243.

MTConnect Update

Technical Advisory Group meeting held in Plymouth, Ind.

The MTConnect Technical Advisory Group (TAG) meeting was held in Plymouth, Ind., on June 19-20, 2012. Forty-four members attended the meeting, which was hosted by Joel Neidig and ITAMCO. The next TAG meeting will be in fall 2012. For further inquiries, please contact Hilena Hailu at 703-827-5293 or hhailu@mtconnect.hyperoffice.com.

MTConnect discussed at events in June

MTConnect was the topic of a keynote Dave Edstrom, President and Chairman of the Board for the MTConnect Institute, gave at the CAD '12 Conference in Toronto, Ontario. Titled "MTConnect: How an Open Protocol is Changing Manufacturing," the talk outlined the business and technical benefits of embracing a royalty-free standard in manufacturing. Dave also gave a webinar keynote for GlobalSpec's Summer Conference and spoke to industry professionals around the globe about how MTConnect can bring end-to-end interoperability to the

manufacturing environment. For more information about MTConnect related events, visit www.mtconnect.org.

MTConnect Forum is in beta

The MTConnect Institute unveiled the beta version of its online forum at its TAG meeting in Plymouth, Ind. This forum was established to create a sense of community among those who are interested in or are implementing the standard. While the beta is released only to TAG members, the final version will be released to the public mid-July. For further information, please contact Hilena Hailu at 703-827-5293 or hhailu@mtconnect.hyperoffice.com.