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MOTION CONTROL & Related Technologies

Buyers' Guide 2007/08

Motion Control Roundtable

Canada's motion control leaders debate the major issues facing the industry.

Topics include trends, protocol options and the plus and minuses of centralized and distributed architectures.

They also discus how Canadian manufacturers can adapt to the new economic realities of a rising dollar and growing global competition.

Participants (left to right) Rich Dirker, Agile Systems; Joe Otterhof, Beckhoff Automation; Scott Evans, Danaher Motion; Chris Murray, Myostat Motion Control; Matheus Bulho and Steve Glover, Rockwell Automation

Motion Control Roundtable '07

Canadian motion control leaders tackle some of the industry's biggest questions

Conducted by Mike McLeod

Which products or product categories have seen the most growth?

Rich Dirker, Product Manager, Agile Systems: On the motion side of our business, our strongest verticals are semiconductors, life-sciences and electronics assemblies, so we have seen tremendous growth in high-precision motion, driven by the ever-increasing requirement for metrology. As the chips get finer and finer, their manufacturers need more and more positioning accuracy and they need to push out products faster.

Joe Ottenhof, Regional Manager for Canada, Beckhoff Automation: That's a hard question for us to answer because it is more concepts we see gaining traction. For us, that concept is simplifying the automation infrastructure by moving from a hardware-based solution to a software-based solution for motion and utilizing high-bandwidth networks to do that. The idea is obsolescence avoidance, since it takes the intellectual asset out of proprietary hardware-based devices and puts it in the full control of the customer. They can then repurpose that software to serve another function in the future, and it will run on any platform.

Scott Evans, Director of Drives - North America, Danaher Motion: By virtue of not having the kind of market share in Canada that we do in the U.S. and Europe, we see growth across all our products in Canada today. That said, we do see a slightly higher rate for very high-performance, not-so-feature-rich products into applications where extreme precision and reduced scrap are important. We are also seeing slightly higher growth for the fieldbus-centric drives across all performance levels.

Chris Murray, President, Myostat Motion Control: Integration is definitely an ongoing trend, and there are varying degrees of integration in the motor field. Originally, you'd get an integrated motor with a driver; or driver and encoder; or driver, encoder and controller. Now, what we are seeing are motors with drivers, controllers, encoders, I/O capability, PLC-like programming and fixed scanning rates, and also integrated power supplies. So we are getting to a point where we've integrated just about everything that you can, except for some kind of digital HMI.

The other thing that we are seeing is a move away from pneumatics to electric actuators. We are involved in a couple of large projects where the end user has specified that pneumatics aren't to be used and they are moving to electric for energy efficiency, reduced noise levels and accuracy. I think this is something actuator manufacturers are currently struggling with, but there is a big push on for an actuator with the right speed, force and price point.

Matheus Bulho, Product Marketing, Kinetix Motion Control (Rockwell Automation): Some of the major product trends we've seen are related to architecture simplification and flexibility.

On the topic of simplification, we continue to see the trend toward more and more integration of the different control disciplines into a single architecture designed for plant-wide control. By having fewer parts and components, you have fewer things to buy, install, configure, program, stock and maintain, which can all add to the overall lifecycle cost of the control system infrastructure. Some examples include the integration of machine kinematics functions, information management, process functions and safety in addition to motion and discrete control.

The trend toward flexibility centres on changing mechanical components to servo-driven technology. What we see growing are customers adding axes to their machines not only to migrate the mechanical infrastructure into a more flexible and reliable software-based architecture but also to add more flexibility to the types of products being produced and managed by a particular piece of equipment.

"Industrial Ethernet" seems to be the hot phrase, but what should companies keep in mind when assessing the range of fieldbus/protocol technologies available?

Agile/Dirker: We come from a slightly different perspective. From the beginning, our applications had vision systems incorporated, so we use FireWire as our core technology, even though we also offer an Ethernet IP interface.

For a motion control supplier like us, we have a difficulty in that there are so many fieldbuses out there. And when we talk to people, they all want something different. The way we have chosen to address this, since we are in the high-performance space and rely on the fast through-put of the network, is to use FireWire internally between axes for the time-critical coordination stuff. To communicate with the outside network, customers can install a translator to any other fieldbus technology to exchange status information and other management data.

Beckhoff/Ottenhof: I don't think there is going to be a dominant protocol, so the question to ask is do these protocols support one another so that no customer is bound by one of the technologies? Customers should look for a protocol that supports other emerging protocols.

Users should also assess what it is they are trying to do with their Ethernet infrastructure. Some networks are really most at home with controller-to-controller communications, and some are more at home with I/O applications. If you are trying to do I/O tasks, then look for a network that is essentially an I/O network. If you are trying to coordinate various types of machines together, look for a higher-level network that supports more controller-to-controller-type functionality rather than I/O-type functionality.

Danaher/Evans: First, let's agree we should stick with Ethernet options that are hardware-compliant to IEEE 802.3. This is the same hardware standard the computer industry uses.

Given that, one should first consider what level of synchronization

Rich Dirker, Product Manager, Agile Systems

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their axes require. There are three transport layer categories that can be classified, in a simplified manner, as non-real-time (NRT), soft-real-time (SRT) and hard-real-time (HRT). NRT is one of the most popular for basic control, such as pushing data from an HMI into a register on the drive/control or for acquiring data from a device.

SRT is popular for coordinating axes during staggered and simultaneous moves or just to control very high-axis-count machines, such as high-speed sorters. Often, these devices can "talk" directly to each other (horizontally or in a distributed manner), as well as to upstream and downstream devices (vertically or in a centralized manner). HRT is for ultra-precise synchronized-path motion and contouring, such as in machine tool.

To achieve HRT, manufacturers may recommend equipment that uses proprietary hardware (at either the head-end or follower-end or both) and will typically bypass the TCP/IP stack. This usually means a closed system with few vendor choices or even a proprietary system with one vendor choice.

Select HRT solutions only when you are sure you absolutely need these benefits. In my opinion, less than five percent of applications outside the machine-tool industry require HRT control. The secondary benefits may suit you, even if you do not require the precision.

For NRT and SRT applications, we recommend you deploy the most popular open protocol and/or one that one or more large companies support. This is your greatest assurance that you will be supported no matter where you ship your machine.

Myostat/Murray: What to look for is usually dependent on what kind of system you are building. If you are putting together a factory and you are doing process control, then you are very much interested in gathering 25,000 data points within a second so that all of your factory processes are mapped out beautifully on your graphic display. If you are making a small machine that has a couple of axis of integrated motion on it, some sensors and some sort of laser marking or curing device, then bandwidth requirements are not nearly as demanding, but you may still be sold into a proprietary format that is perhaps overkill for what you are doing.

My feeling is that if someone is looking at Ethernet as a bus, you don't really have any freedom to choose; the bus you are going to use is really dependent on what hardware you ultimately pick for your motion or for your distributed I/O. European and American automation component manufactures have chosen different standards so your existing hardware preferences, or your customer's hardware preference, will ultimately make the decision for you.

Rockwell/Matheus: When determining whether an industrial Ethernet network is appropriate or not, I think one of the first questions should be: Is the network compliant with standard, unmodified Ethernet? We have seen different protocols in the market that are positioned as "standards based" but basically make changes to fundamental pieces of the Ethernet stack in the hopes of enhanced performance. The drawback is that you are compro-

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missing your ability to leverage off-the-shelf technology, implement lower-cost architectures and stay compatible with what is available over standard Ethernet today. In essence, you start to lose one of the key advantages of migrating to an Ethernet architecture, which is being able to count on a simplified control and information system infrastructure and have multiple disciplines and multiple functions being deployed over a single network.

For more demanding motion control applications, quality of service (QoS) technology, full duplex operation, managed switch technology and the IEEE 1588 standard, which defines a synchronous clock mechanism, provide the ability to synchronize clocks at the devices in the network with better than 200 nano-seconds accuracy. That allows us to perform very high-speed, very high-performance motion control over standard unmodified Ethernet.

What should companies keep in mind when deciding between a distributed versus a centralized control architecture?

Agile/Dirker: We believe that, more and more, the intelligence in machines is being pushed out to the components. The advantage of distributed control is you relieve the central controller from doing the motion tasks. The central controller is still there, but it can now handle more process related functions since it doesn't have to worry about real-time motion. In this way, the central controller can focus on controlling the process aspects of the machine like how many parts get made, how much scrap there is and what the demand from the factory is.

Beckhoff/Ottenhof: The thing about centralized versus distributed control architecture is it's all about coordination. You need to be able to accurately and quickly coordinate what's going on in all of those distributed I/Os and devices. In the past, distributed networks became the prevailing technology because there wasn't enough network bandwidth for the central controller to maintain control. There was too much lag time.

The issue then became, how do we coordinate what's going on so that we get a big picture of the whole machine or of the whole plant? To do that, you had to integrate distributed databases into a common centralized database, which would then be manipulated to give you a picture of what was going on.

On the other hand, if you begin with a centralized architecture, you only have one database to begin with and you are using a network to retrieve raw data from the field devices. You have one controller rather than eight or 80.

The value proposition for PC-based motion control, then, is that the network enables a centralized controller to make "dumb" devices act in a high-performance way. Also, if you have more intelligence in the central device, those field devices can be simpler, much less expensive and require less configuration in the field.

Danaher/Evans: Today, the benefit of centralized control—in addition to the synchronized-path contouring mentioned earlier—is that it is a repository for everything you are doing (code, data, recipe storage, I/O handing, etc.); if you want to make any changes anywhere, you know where to go. The downside to that is, if something happens to that piece of equipment, then you can't run any part of your machine at all. The parts of the body won't work without the brain.

In a modular machine (where axes can operate independently of each other), if one part of the machine fails, the rest of the machine can continue or at least conduct an orderly shut down. Whichever topology you select, try to deploy a system that is common and has a global footprint to assure the greatest post-installation support.

Myostat/Murray: Every engineer thinks their way is the best way. If you look at a dedicated control card, it can do very fancy motion but there is a lot of programming overhead and training required. The result is that centralized controllers can handle applications, such as five axis co-ordinated motion, that integrated solutions cannot. Our philosophy has always been to

create a motor system that a mechanical engineer can use. We have tried to identify what the tricky bits are and simplify them by building them into the core control scheme and giving them a simple interface. The distributed model is based on easy-to-use motion modules and is better suited to two axis contouring or pick-and-place style applications. There are all kinds of reasons to go with integrated and non-integrated. Sometimes they are driven by the engineer and his application, and sometimes they are driven by the investment that has been made or needs to be made. It is very hard to generalize.

Steve Glover, Rockwell Automation Canada: From an application standpoint or an initial engineering standpoint, there are advantages to a highly distributed architecture, but you need to think about the long-term maintenance part of it; you need to have a mechanism for change management. You need to keep that in mind as you go down the road because, to a design engineer, it may make a whole lot of sense to highly distribute control, but realize that this will be in a running facility somewhere. Sometimes driving that logic to the device level may be something that's not understood by the operational and maintenance groups.

In what ways can your company help customers adapt to today's market realities (i.e. increasing global competition, a rising Canadian dollar, etc)?

Agile/Dirker: One benefit of our system, as opposed to a centralized system, is customers can eliminate, right off the bat, a lot of cables, cabinets and basic wiring of interlocking signals throughout the network.

Beckhoff/Ottenhof: Technology, I think, is an enabler. If you are going to differentiate yourself from your competition, you need to realize that, sooner or later, you've got to step out of line and implement new technologies. If you hide your head in the sand and refuse to learn new technology, what happens is you get a productivity rating in Canada that is lower than it is in virtually every industrialized European country. If Canadian manufacturers can embrace new technology rather than fight it, then they would have the opportunity to overcome the increasing value of the dollar by adding increased value to their scope of supply.

Danaher/Evans: While the strengthening Canadian dollar might pose a problem for companies shipping to the US, the Canadian dollar isn't necessarily getting stronger against the Pound Sterling or the Euro. It's a safe bet these companies are probably promoting their products in those countries. To that end, Canadian machine manufacturers will want to partner with larger companies who can support them all over the world. Danaher Motion is one of those companies. We are a billion-dollar company with offices in over 20 countries, and factory-trained agents in many others.

Myostat/Murray: Our concept has always been to bring in innovative and cost-effective technologies from Asia. The Asian market is much more price sensitive than the U.S., so we can often bring in automation components and sell them at a better price. A lot of the product that comes up from the States is overpriced in Canada, which further reduces the competitiveness of Canadian integrators.

Rockwell/Glover: We feel that adopting new technology and integrating motion with machine control is the way to stay competitive in an environment that has changed from historical norms. The smart guys know that they have to. Some of the other people understand it too, but they still use that traditional design methodology to try to accomplish that. If they are an OEM or if they are manufacturers, they can try to bid on a contract but they aren't going to have that 35 percent advantage that they had before. What we find is that the progressive companies want to maximize the assets they've got, and they find that the implementation of technology is the way to do that. DE