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CONTROL ENGINEERING

JANUARY 2008 C rol, instrumentation, and autom worldwide

Closing the Skills Gap 34

PRODUCT EXCLUSIVES: 10
Secure WiFi module
Dual-line process meter
Photoelectric sensor

CE TV Exclusive:
Optical Fiber Manufacturing case study

‘Makeover’ for manufacturing

No matter what your company produces, product innovation and process efficiency keep you one step ahead of the competition. An increasingly scarce supply of new engineering talent joining the ranks, however, could place that competitive advantage at risk.

The good news is that an incredible amount of energy and creativity is being invested in reaching out to young people to engage and inspire. For evidence of this, look no further than some of the organizations featured in this month’s cover story. Motivating students is critical to the long-term health and success of our industry, but the need to give manufacturing a public “facelift” is of equal importance.

If you’re reading this magazine, website, or newsfeed, you already know that manufacturing is alive and kicking and that the plant floor is becoming a playground for new technologies. From the emergence of wireless solutions to the free flow of information through the enterprise, today’s production environments are technologically advanced and highly-sophisticated. The average person on the street, however, isn’t likely to share the same view.

“A large part of the problem is that mainstream media outlets seem to have an affinity for negative stories from the manufacturing sector.”

A large part of the problem is that mainstream media outlets seem to have an affinity for negative stories from the manufacturing sector. If 24/7 cable news networks were your only source of information, you would be led to believe that all manufacturing jobs will be outsourced, all products made offshore are of questionable safety, and that the future of U.S. manufacturing is bleak.

The industry has its challenges to be sure, but what is conspicuously absent from the public consciousness is a more accurate, less sensational view of the market. We operate within a global economy, and in many ways the world is getting smaller, but the flow of product and production can be bi-directional. Of course some manufacturing operations have moved offshore, but some global manufacturers open and operate massive facilities in North America with great success. (Can you still call a Honda CRV an “import” if it was made in Ohio?)

To help turn the tide, there is no substitute for providing people with first-hand experience. Bring your kids to work, host a plant tour for a local school, start a blog… anything to get the word out about manufacturing in a positive light. Simply sharing enthusiasm for your vocation can have a dramatic effect on those around you and provide some much needed perspective on the state of our industry.

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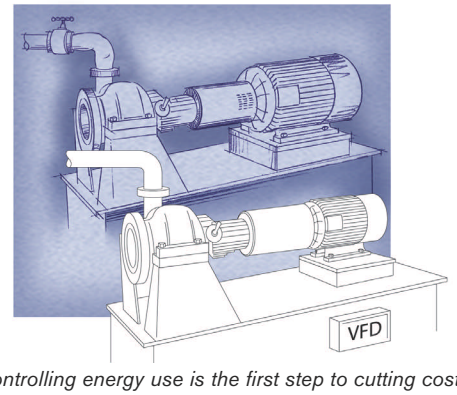
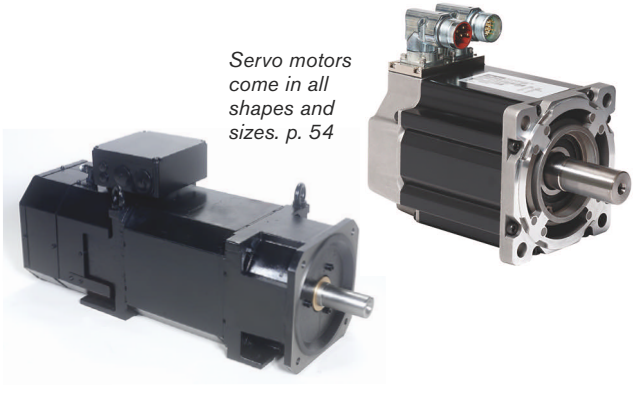
Training future generations of control engineers should start early. p. 34.
Illustrator: Tom Rybarczyk, Reed Business Information



Controlling energy use is the first step to cutting costs. p. 42



Servo motors come in all shapes and sizes. p. 54

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Inside Process

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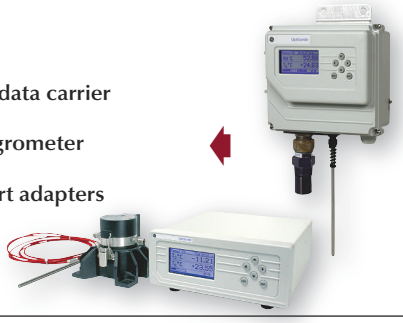

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CNC open architectures

Krzysztof Pietrusewicz, Ph.D.
Control Engineering Poland

Most computer numerical control (CNC) systems are closed for users. Engineers typically can only program the machine, nothing more. Even if it has a so-called programming interface (including 3D visualization and process simulation, pre-defined milling/turning cycles, or even a small CAD/CAM system), it cannot be freely modified by the user.

Open architecture control systems, however developers understand them, are a noticeable trend of modern control systems technology. "Open" is a very fashionable way to describe today's control systems.

Many efforts are underway to make control system architectures more open. It helps to define the degree of openness of the proposed control system.

Evaluate CNC openness

A variety of open-architecture control systems can be found on the Internet. These include OSACA (Open System Architecture for Controls within Automation Systems), OMAC (Open Modular Architecture Controllers), NGC (Next Generation Controller project, National Center for Manufacturing Sciences), and OSEC (Open System Environment for Controller) control architectures, as well as others.

> "Many efforts are underway to make control system architectures more open."

But what defines CNC openness? Can the degree of control system openness be measured?

A means for rating the openness of major control system attributes is provided in Chi Yonglin's paper, "An evaluation space for open architecture controllers" (*International Journal of Advanced Manufacturing Technology*, 2005).

Rating categories include applicable control system domain (0 rating means that the controller has been designed as special equipment; a 10 rating means it can be used for all domains of the manufacturing industry), as well as extensibility and scalability (0: traditional closed architecture, 10: a full open architecture whose topology can change depending on the application.)

Similar measurements can be made for other aspects of openness, such as modularized structure, standardized interface, function and performance requirements and more.

Once the relative "openness" of a system is ascertained, however, the truest measure comes when putting the technology into action within a production environment.

Project OCEAN

Project OCEAN (Open modular Control system for linEAr motioN drive) is a research grant of the Polish Ministry of Science processed by the research team of the Centre of Mechatronics, Szczecin University of Technology.

Nearly seven years of research includes:

- Modeling of milling machine construction;
- Development of many control algorithms, including robust two degree of freedom, fuzzy-logic, neural networks, predictive and hybrid control;
- Laser 3D vibration monitoring; and
- Modeling of the feed drives of CNC machines.

Project OCEAN is among four ongoing mechatronics projects undertaken by an interdisciplinary team at University Centre of Mechatronics, Szczecin University of Technology. The team includes five professors, six doctors, four Ph.D. students, and OCEAN project director professor Stefan Domek, with the faculty of Electrical Engineering.

Self diagnostics for machine tools

OCEAN's main goal is to introduce an open interface to develop diagnostic functions of the milling machine, test it, and introduce it to users. It includes:

- Motion control advanced algorithms;
- Different interpolation algorithms, including NURBS (Non Uniform Rational Basis or Bézier Spline), mathematical representations of 3D geometries;
- Flexible human-machine interface (HMI);
- Options to extend system kernel functions;
- Interface for the new flexible programming language; and
- Interface for the new active control system of the motion components.

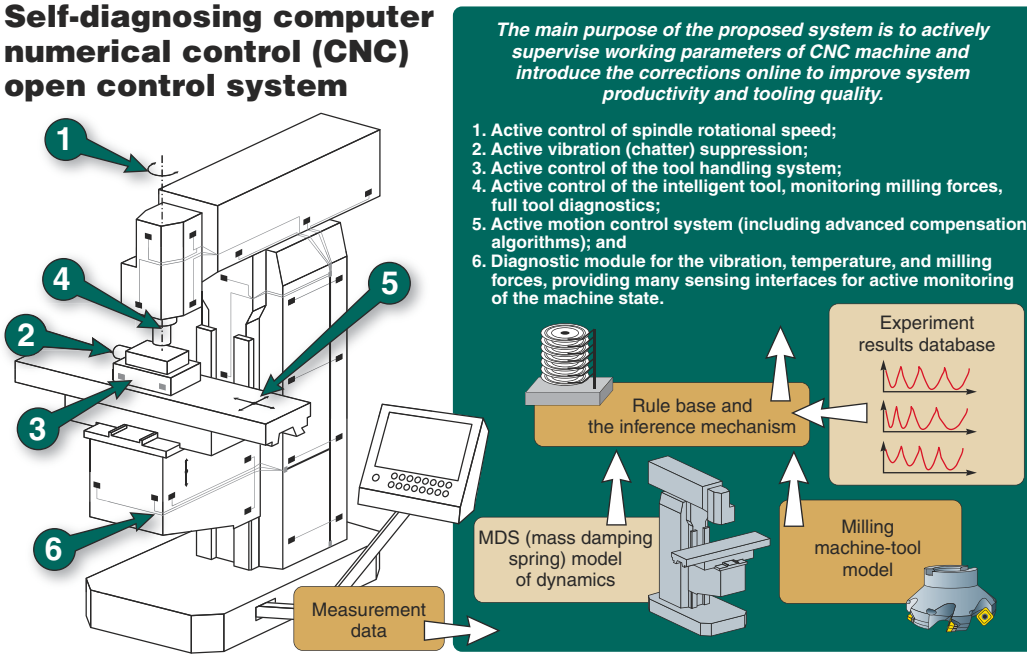
Next, the project will develop:

- Full temperature model of the milling machine structure;

ONLINE

Find more in January 2008 www.controleng.com/archive:

- **CNC Programming (STEP-NC data model)**
- **CNC vendors**
- **System integrators with CNC expertise**



Intelligent CNC machines will diagnose themselves. Source: K. Pietrusewicz and Control Engineering

- Intelligent, self-diagnostics tools; and
- Noise and vibration control (active chatter suppression system of the tool-milling machine system is at the final stage of development).

University Centre of Mechatronics is seeking new partners for the next steps of the system; present cooperation is provided by Bernecker & Rainer, a Technology Provider and Integrator Member of OMAC. Project OCEAN is scheduled to be completed in 2010. Two more projects connected with the concept of intelligent CNC machines also will begin this year.

Open CNC architectures

The use of open architecture CNC is gaining importance as a promising industrial automation technology. It allows integration of equipment, a friendly interface for configuration, and improved machine tool communication. Benefits of using an open architecture when developing new CNC includes lower-cost electronics and higher-performance computers.

Several types of open architectures are being developed in the USA, Europe, and Asia. All use a standard PC computer for control.

OSACA is used mostly in the software area. It first appeared in Europe with the Esprit III Project 6379 program, one of the largest projects involving standards for OAC (Open Architecture Control), including network connections and applications, defining an independent hardware with modular design, and allowing addition or removal of numeric control, robot control, PLCs, and other controllers.

OMAC is primarily for industrial applications. OMAC began in December 1994 with the publication of "Requirements of Open, Modular Architecture Controllers for Applications in the Automotive Industry" by Chrysler, Ford, and General Motors. This document served as a guide for North American automotive manufacturers' use of controllers.

OSEC architecture is used for automation in many industrial areas to control manufacturing equipment, improve its performance, and facilitate its maintenance.

HOAM-CNC (Hierarchical Open Architecture Multi-processor) system is for hardware (including new sensors and special modules).

Each architecture has integrated equipment from several manufacturers and the overall goal is to lower cost and not sacrifice performance.

For more information, read this article online at www.controleng.com/archive.

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