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machine intelligence

Advanced Motion Control for Machine Designers

Saving dough

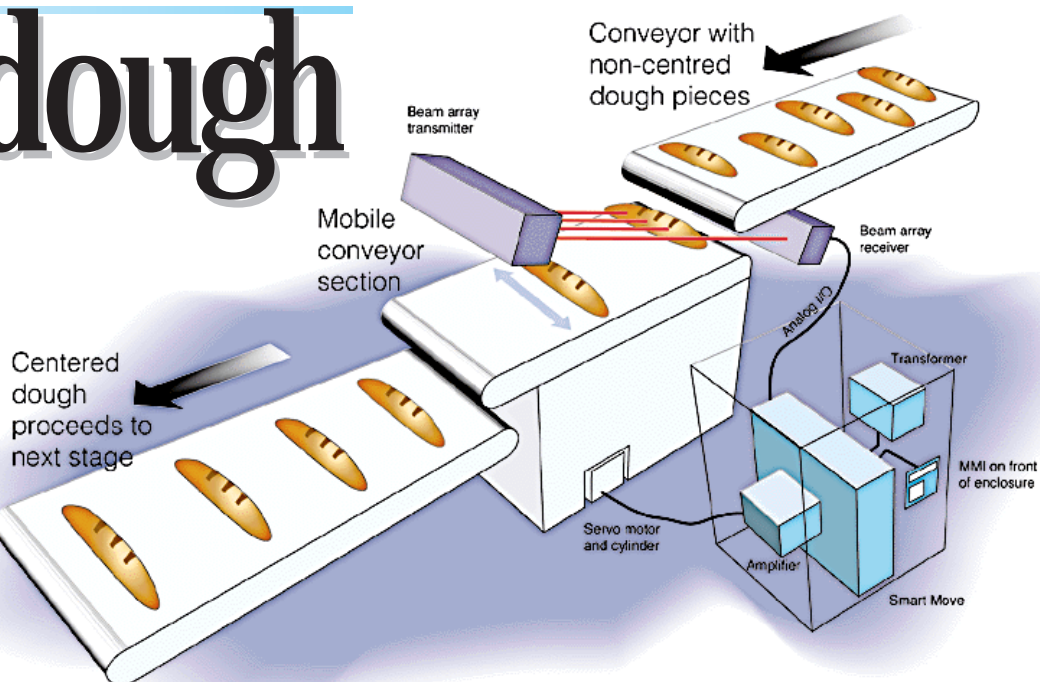
The built-in programming language and analog I/O of the SmartMove motion controller is helping eliminate scrap on a hearth bread and roll processing line for leading US baker, Pepperidge Farm.

Dough is tricky stuff to handle, so much so that it will move of its own accord when it's being conveyed along a process. So, photoelectric eyes are often used to detect if dough balls are off-line and could cause a problem. The trouble is, this technique is so coarse that slightly off-line dough can end up being stretched and cut into unacceptable shapes, creating scrap.

This was the situation on a hearth bread and roll line at the Lakeland, Florida plant of one of the USA's major nationwide bakers, Pepperidge Farm. They asked automation experts PACE to devise a better control system. PACE engineer Brian Romano decided to employ an LED beam array - a component used in light curtain safety systems - to provide precise data on the actual position of the dough ball, and then to correct the problem by shifting a conveyor section in real-time using a servo-driven cylinder.

Baldor Optimised Control's SmartMove was a natural choice for the motion controller, because of its built-in analog I/O, and for its programming language: "MINT really makes a difference to productivity" says Brian Romano. "You're using clear high-level commands, just like BASIC but with extra motion functions, and you can add comments to document programs." This is almost revolutionary compared to most other manufacturers' products, he notes, which often involve assembler-style programming using cryptic mnemonic codes, and sometimes highly restrictive program structures - making systems difficult to modify and maintain. On average,

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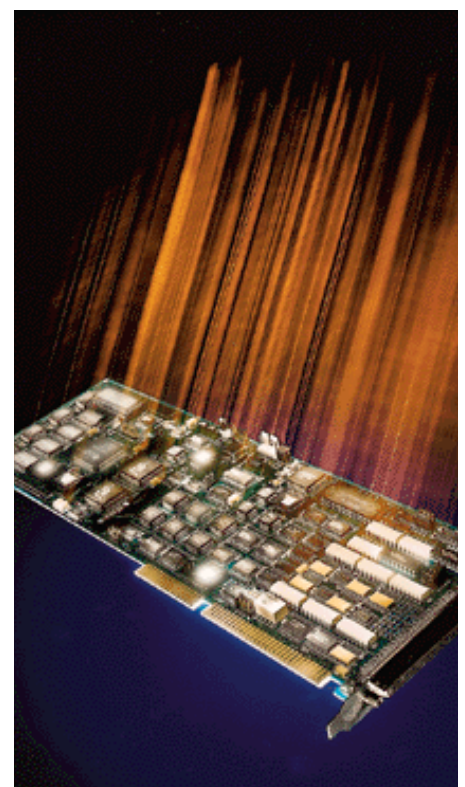


Ultrafast motion controller for PC-based machines

Baldor Optimised Control is fuelling the trend to embed PC-based control and user interfaces into industrial machinery with an exceptionally fast PCbus motion controller. Offering up to eight axes of control for stepper-, servo- and CAN-based motor drives, the board runs at 40MFLOPS, providing awesome performance for implementing demanding motion applications.

This provides ample computing power to interpolate up to eight axes for example, and to generate real-time feedback on parameters such

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'Motion package' speeds CNC router development

Specialist woodwork supplier Jali Ltd is building a new generation of routing machine, capable of machining complex woodwork products with much greater efficiency. Jali sees conventional CNC routing machines as too limited to serve this market well, and has added a powerful PC front end and materials handling system to a traditional CNC router machine to create a more flexible solution. The result is a friendly design-to-production system that can create shaped products for Jali's customers in the architectural and shop-fitting market, as well as custom sets and props for the film industry - such as the decorative 'ironwork' it produced for *101 Dalmatians*, or the 'spaceship' being made for a forthcoming Hollywood blockbuster.

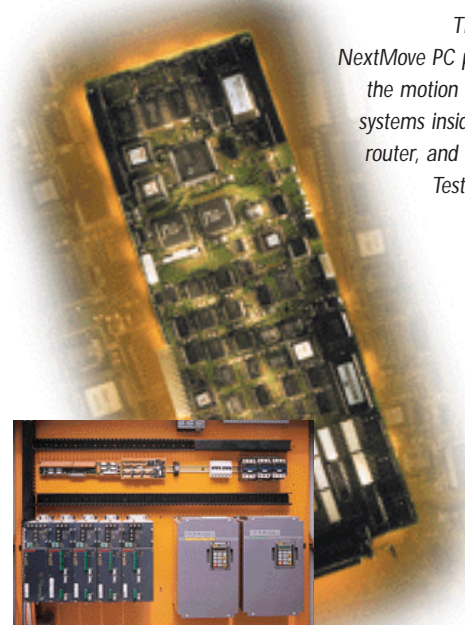
According to Jali MD Nick Showan, PC technology is key to creating a more flexible machine which links easily with CAD and is easy to control and operate. This liberates Jali from the proprietary control system architectures that CNC manufacturers tend to provide.

Jali's work is being done in two stages: first is a 3-axis materials handling system and PC front-end, retrofitted to a CNC router used in the aerospace industry. Entering production now, this system is easy to program and use, capable of running much larger programs than the average CNC machine, and offers a very large working area for fibreboard of 1.6x11m. The next stage is to build a 16-axis version, which will allow Jali's process to run continuously rather than in batches.

The motion architecture is based on Baldor's NextMove PC controller, with eight axes of servo control. "We chose this module largely because of Baldor's high-level MINT language and its local technical support. Clearly, this is critical during the current development-intensive phase, while we're proving our PC motion control ideas", adds Showan.

Jali has also taken advantage of Baldor's ability to supply the complete package, including drives, motors and cabling, to simplify purchasing and speed the integration of the final system. Baldor's uniquely-wide range extends to very

high power levels, so this package, which Showan hopes will cut weeks from the system integration cycle, even included the vector drive for the machine spindle.



Baldor supply the complete 'package' to Jali

The fast NextMove PC powers the motion control systems inside Jali's router, and Matrix Test's ATE.

continued

Saving dough

MINT can reduce program size and implementation time by up to a third, he estimates.

At Pepperidge Farm, a 100-line program is loaded into SmartMove's non-volatile memory to automatically correct dough position on a short conveyor section before it reaches the 'stretcher board'. This program detects the edge and the width of the dough ball as it passes the beam array, then uses MINT's math capability to compute any necessary correction, and move the servo-driven cylinder.

Baldor's simple operator panel is connected to the SmartMove to provide some basic controls over the process, and to display error messages. Thanks to built-in operator interface keywords in the MINT language, this was implemented using just 20 lines of code: a half day's work for PACE even though this was the first time they had used this accessory. This level of flexibility is unusual in the servo controller industry, Romano notes; other controllers typically require you to source your own man-machine interface components and write custom code for them using a serial link.

PACE can be e-mailed at: pacenh@aol.com

continued

Ultrafast motion controller for PC-based machines

as velocity or position for sophisticated man-machine interfaces. Applications include advanced robotics or CNC, and the control of cutting/printing/sealing on high-speed web processes. The module is equally at home in lower performance motion systems, thanks to the use of the economic PCbus form-factor, and the ability to purchase it at different populations.

Dubbed NextMove PC-2, the new board is an upgrade of NextMove PC, one of the most widely-used PCbus multi-axis motion controllers in the world today with thousands of installations. Now based on a 40MHz version of the 32-bit TMS320C31 DSP, with zero wait-state RAM, the board approximately doubles software execution speed.

Compatibility with MINT software simplifies application programming by providing ready-to-use commands for many sophisticated motion control tasks such as X-Y tables, flying shears, splines and software cams.

NextMove PC-2 is optimised for OEM

applications, and its dual CAN (Controller Area Network) channels offer a flexible resource for cutting the cost of motion control subsystems, allowing I/O to be linked via a common low-cost network cable. This can save many hundreds of pounds in wiring alone. It can also greatly simplify the design of large machines - as used in textile, web or packaging processes for instance - by allowing I/O and user interfaces to be sited precisely where needed.

Although networked drives are not ideal for very high speed motion control, Baldor's provision of two CAN channels provides the performance to support almost every auxiliary motion axis, such as those required for materials handling or vision systems - common needs for packaging and assembly machines. This allows the motion control part of the machine to be segregated from system-level and I/O communications, providing a dedicated link capable of responding rapidly.

Multi-axis controller revolutionizes 'flying probe' test

Two 8-axis NextMove motion controllers are at the heart of a new machine which is speeding 'flying probe' test of bare printed-circuit boards by up to an order of magnitude. The new PC-controlled machine, from Matrix Test, uses an ingenious system of 'flying grids' with 216 probes each to decrease the acceleration, speed and complexity of probe positioning, providing an economic test solution for surface-mount PCBs.

Matrix Test's flying grid idea means that moves of less than 1mm are needed to access any circuit net, allowing the probe system to use economic and reliable stepper technology instead of more expensive and complex servos or linear motors.

In all, Matrix Test need 13 axes of control, 8 of which control the X-Y motion of four flying grids. These eight axes use a novel encoder-based system to maintain accuracy. As with any motion system, minute amounts of drift creep in through factors such as backlash. Each test pad is typically 75 microns wide, and although the error for an individual move might be just a few microns, a complete test sequence could entail many thousands of moves and the total error would quickly become significant if uncorrected. So, after each move is made in its optimum-speed 'open loop' fashion, the actual position is read back and used on-the-fly to adjust the following move. This simple approach allows Matrix Test to make moves in around 20msec, compared with 100-200+ for a typical 'flying probe'.

The other axes on the system control PCB loading and positioning, a Z axis to adjust for different thickness PCBs, and a

camera which provides feedback to correct for factors such as 'artwork stretch'.

Matrix Test faced two problems when seeking a solution to its motion control requirements. The first was the high level of integration: for economy it wanted a controller that offered a large number of axes; only a couple of suppliers offered solutions with as many as eight. The second issue was compatibility with Windows NT, the platform Matrix Test had chosen to control the machine and provide an operator interface. This narrowed the choice to just one product: the NextMove PC from Baldor.

Baldor's Windows interface library provided a number of development approaches to Matrix Test, and it chose to base the system on the MINT motion control language, providing a stream of high-level axis positioning commands from the host PC into each NextMove board's buffer. These commands are then executed using NextMove's on-board MINT interpreter. This approach helped to build a working machine very quickly, one which was capable of performing positioning moves in just 60msec. But ideally, Matrix wanted even faster performance and asked Baldor for advice. A decision to switch to C was made, and Matrix Test used the library of MINT-compatible C routines to convert the code.

"Making the changeover to C allowed us to cut the time needed for moves by around two thirds, and remarkably, took just a day or so to make thanks to the advice of Baldor" notes Matrix Test's Colin Barker. "The development support for this motion controller has really helped bring our new product idea to market quickly".

Optimising CAN systems

Baldor Optimised Control has added DeviceNet support to its fieldbus range, complementing CANopen and providing motion system designers with a means of fine-tuning performance. With this protocol choice, designers can now configure CAN systems biased towards real-time control, or simpler integration with factory automation.

Baldor is one of the few motion control companies to make a serious commitment to fieldbus technology. Following several years' experience providing CAN interfaces on controllers, this decision to extend software options really rounds out our range, allowing designers to make the best choice for individual markets, rather than trying to impose one standard. With these two protocols to choose from, designers can decrease code size to minimize the cost of the embedded control system for a high volume product for example, or provide PLC users with a ready means of connecting motion I/O to their equipment; the table summarizes our opinions on the relative merits of CANopen and DeviceNet.

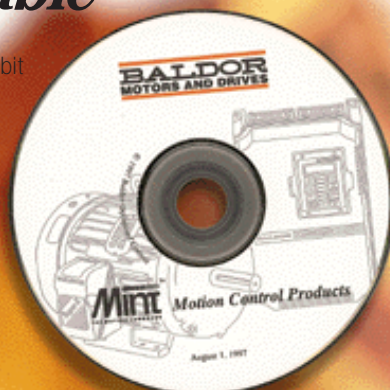
	CANopen	DeviceNet
Relative code size, operation speed	small, fast	medium, medium
Flexibility	easily optimized	more rigid, many standard services
Level & type of support	I/O, sensor & actuator oriented, strong in Germany, Europe	from I/O & sensors to PLCs/PCs, strong in US, UK
Application focus	real-time control, machine building	broad scope, good at factory network level

DeviceNet will shortly be added to NextMove BX, allowing this product to operate as a Group 2 Slave. Using the DeviceNet protocol, users can read or write MINT 'Comms Values', providing a flexible method of communicating any kind of variable, such as information on the material being handled, or system data.

The benefits of fieldbus-based control systems are, by and large, well understood, and include reduced cabling and simpler system building and operation. But for those considering them for the first time, there's a useful introductory paper on Baldor's free CD-ROM.

"Un-put-downable"

Well, it's a good, solid read, even if it is a bit dry at times. What are we reviewing? Baldor Optimised Control's new CD-ROM. It's packed with hundreds of pages of manuals, training presentations, datasheets and more, on motion controllers and the MINT programming language. It's ideal for the literature shelf of any OEM who integrates motion sub-systems, and it's free. To get your copy, phone your local office.





What's in the 'package'?

The acquisition of Optimised Control by Baldor Electric has created a unique organization capable of supplying complete motion system solutions with position controllers, drives and motors. This capability allows us to reduce customers' costs by broadening purchasing and supply agreements. The key benefits of 'package' agreements include:

- **Vendor reduction** Administration costs are reduced greatly by purchasing complete motion systems from one source
- **Lower costs** Breadth of range greatly fuels the ability to enter into cost-effective 'corporate purchasing agreements' with larger OEMs who make Baldor their sole supplier
- **Lower lifecycle costs** Standardization on one range eliminates system integration problems, and reduces the need to hold spares - lowering costs throughout equipment lifecycles
- **Better solutions** Exclusive agreements allow Baldor Optimised Control to focus on problem-solving, helping us get your products to market faster and at less cost
- **Global support** We are now part of an organization with a 55-country network of design, manufacturing and sales resources, substantially enhancing support. Our distributor network will even stock to suit organizations that enter corporate purchasing agreements

For further information: www.baldor.com

Shortform Product Guide

MOTION CONTROL

- **NextMove PC** DSP controller for up to 8 axes of stepper or servo drives, with CAN, I/O, MINT. PC ISA board
- **NextMove BX** DSP controller for up to 4 axes of servo drives, with CAN, I/O, MINT. Panel-mount book-style case
- **NextMove RK** DSP controller for up to 4 axes of servo drives, with CAN, I/O, MINT. 6U rack-mount Eurocard
- **EuroSystem** low cost 3-axis controller for servo or stepper drives, I/O, MINT. 3U rack-mount Eurocard (also in servo only [EuroServo] or stepper only [EuroStep] versions)
- **SmartMove** low cost controller for up to 3 axes of servo drives with CAN, I/O, MINT. Panel-mount book-style case
- **SmartStep** low cost integral 3-axis stepper controller and 80W amplifiers, I/O, MINT. Panel-mount open frame

I/O

- CAN I/O networkable I/O modules, including opto-isolated digital inputs, digital outputs, relay outputs, and operator panels

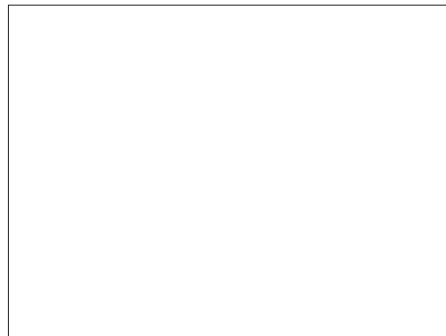
SOFTWARE

- **MINT** motion programming environment which simplifies motion control development via high-level commands for applications such as X-Y tables, flying shears, splines, software cams. Provided as ROM interpreter, or C library
- **Windows** support via the MINT Interface library to interface MINT controllers with 16/32-bit Windows applications. Developers can use host PC for control, or communicate with autonomous motion control subsystems, interpreting MINT or running C routines



Look in the book

RS Components has added the 3-axis, Eurocard rack-mounting motion controllers, EuroSystem and EuroStep, to its UK motion control catalogue sales section, providing an off-the-shelf source of supply for OEMs and automation engineers. This interest, from one of Europe's premier catalogue distribution operations, is undoubtedly a compliment to the simplicity and broad appeal of the widely-used MINT programming language.



Like more information?

Access our web site, phone or e-mail your nearest office to get further information on any of our products or services:

Baldor Optimised Control (UK)

Tel: +44 (0)117 915 3200
Fax: +44 (0)117 915 3201
email: sales@baldor.co.uk

Baldor Electric Company (USA)

Tel: +1 501 646 4711
Fax: +1 501 648 5792
email: sales@baldor.com

Baldor ASR GmbH (Germany)

Tel: +49 (0)89 90508-0
Fax: +49 (0)89 90508-492
email: sales@baldor.de

Baldor ASR AG (Switzerland)

Tel: +41 (0)52 647 4700
Fax: +41 (0)52 659 2394
email: sales@baldor.ch

Baldor Italia srl (Italy)

Tel: +39 (0)11 562 4440
Fax: +39 (0)11 562 5660
email: sales@baldor.it

Australian Baldor Pty Ltd

Tel: +61 (0)2 9674 5455
Fax: +61 (0)2 9674 2495

Baldor Electric (Singapore)

Tel: +65 (0)744 2572
Fax: +65 (0)747 1708