

Motion Intelligence

advanced motion control technology for machine designers

Issue 5, Summer 2003:

- Applications: - antenna control
- surfboard shaping
- zip insertion
- using NEMA motors

- New products for 2003:
Brushless servo drive
Profiling software
AC drive family
Multi axis motion controller
BSM C-series servo motors

New products enhance motion control architecture

MicroFlex - low cost servo drives

The panel-mounting MicroFlex brushless AC servo drive provides the means to squeeze extra performance out of motion machinery, while also trimming costs. Although designed for low cost and volume manufacture, the single-axis drive nevertheless incorporates advanced features to improve motor speed and smoothness of motion, including Space Vector Modulation (SVM), and high resolution Synchronous Serial Interface (SSI) and incremental encoder feedback. By controlling IGBTs using SVM instead of the more usual PWM, users can run servo motors at typically 15% higher speeds with reduced switching losses and harmonics – which can translate directly into greater machine throughput. SSI feedback can provide a similar boost to performance, by providing high resolution absolute positional data on every servo loop, enabling tighter control of velocity and positioning.

Continued on page 2.



Precision positioning of radio telescopes

Baldor motion components are providing the ultra precise movement components required to control the positioning of Brazil's new radio telescope system, the Brazilian Decimetric Array (BDA).

Developed at Brazil's INPE space research institute, the telescope is designed primarily to monitor the sun and predict space weather. When fully installed, the BDA will provide a T-shaped array of 38, 4-meter (13') diameter, mesh antennas laid out along base lines of 2.5 x 1.25 km (~1.5 x 0.8 miles).

All the antennas track the Sun synchronously and continuously, and the position control system must offer extreme positioning resolution and tracking accuracy to achieve this, because of the large physical spacings involved, and the micro movements needed to rotate the antennas.

Two servo motors are used to control each antenna's tracking movements, to drive the azimuth and altitude axes.

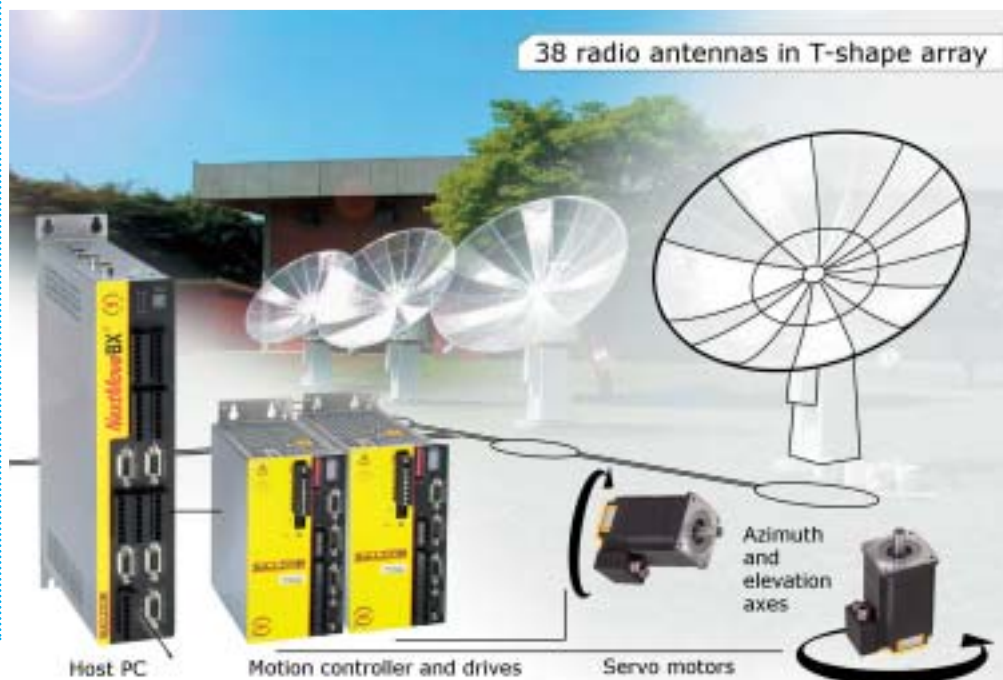
The designers of the positioning system on this project, Inteltek Automation (Pune, India), chose a Baldor NextMove BX motion controller for the task, together with a combination of Baldor drives and brushless AC servo motors.

Continued on page 2.

Application:
Multi-axis precision positioning system

Motion controller:
NextMove BX, Mint software

Key design advantages:
Multi axis capability
Rugged enclosure
Autonomous control using Mint programs for interpolated movement



New products enhance motion control architecture

Continued from page 1: This allows the low cost servo drive to be used in the highest precision applications, such as precision profiling or PCB assembly. MicroFlex also supports trapezoidal commutation (in addition to sinusoidal), allowing OEMs to reduce hardware costs even further by employing encoderless motor control loops.

NextMove-ESB - 7 axis motion controller with USB

High speed serial interface technologies are starting to migrate from the PC to industrial worlds – providing automation OEMs with interesting opportunities for simplifying the way they build equipment. Baldor's new NextMove-ESB all-in-one motion solution provides an interesting example. Offering control for three servo and four stepper motor axes

on a panel-mounting package, together with onboard I/O, fieldbus connectivity – plus a USB interface – it provides a rugged motion solution that eliminates the system integration difficulties that plug-in PCI or PCbus boards pose. With this combination of servo and stepper control capability it could, for instance, implement a standalone X-Y-Z axis positioning solution - supported by four stepper axes and I/O for material handling and machinery control. Moreover, if the module is used with Baldor drives, it is capable of controlling up to seven precision servo motor axes. Onboard I/O completes the board's capability, allowing users to employ the module for machine control as well as motion - potentially eliminating the need for a separate controller such as a PLC.



Precision positioning of radio telescopes



Continued from page 1:

Operating at just 0.6 RPM, the motors drive the loads through a combination of reduction and spur gearing to provide a positioning resolution of just 2.5 arc-seconds, at wind speeds of up to 60 km/hour (37.5mph).

NextMove BX was well suited to this control task because of its combination of facilities, including multi axis capability, ruggedness for easy mounting underneath the antenna dish, and its built-in Mint motion language.

NextMove BX units link to a host PC using a multi-drop RS-485 network. Running custom position control software, the PC transmits new position commands to the remote motion controllers at intervals of typically 60 seconds. The motion controllers' Mint application programs then autonomously provide interpolated movement commands to drive the azimuth and altitude servo motors, which ultimately move the axes at around one thousandth of a revolution per minute following gear reduction ratios of 800:1. Before starting to install the BDA system, prototype dishes were tested in India. The measured accuracy of the positioning and tracking was less than three minutes of arc.

BDA was developed under the direction of Professor Hanumant Sawant of INPE. The project is funded by São Paulo's State agency, FAPESP.

Shaping the future of surfing

The Mint language is providing the real-time motion control for a machine that lets surfboard builders automate the production of complex profiles, and allows expert surfers to innovate custom shapes more accurately and rapidly than using conventional hand crafting.

At the heart of the machine from the Australian board building company CET Surf, is a dedicated 3D CAD tool for surf and sail boards called Deadly Accurate Template Designer, or DAT Designer. The machine takes a DAT file, and transforms the shape information into motion control commands. These movement commands are used to machine a surfboard blank by controlling its vertical, horizontal and longitudinal movement as it travels past a rotary finishing head.

The CAD-to-motion control interface is handled by Baldor's plug-in PCIbus card, NextMove PCI, with its onboard Mint motion language. Machine throughput is critical, and the developer of DAT and the CAD-to-motion interface – software engineer Dr Ian Pearce - selected NextMove because of the sophisticated move capabilities that Mint offered, and for the language's developer workbench

support. Among the facilities offered by the engineering environment was open access to key hardware resources. This was used to exploit the card's dual-port RAM buffer to the full - creating a custom PC-to-motion data passing scheme that greatly speeds the transfer of large arrays of shape information.

Using this technique, even the most complex surfboard profiles can be fabricated in around 40 minutes - with minimal need for the post-machine hand-finishing that other conventional techniques such as milling can necessitate.

The comprehensive hardware complement of the motion controller was a second reason for NextMove's selection, as it provided a single-board solution to the real-time control needs – three axes of closed loop motor control plus I/O – together with the flexibility for system expansion. Now that the CAD/CAM machine concept has been extensively proven on local production, and the company is building machines for export, this flexibility is actively being used. The first major system expansion for the team is the addition of a fourth axis to support concave cuts.



Application:
Multi-axis precision positioning system

Motion controller:
NextMove-PCI, Mint software

Key design advantages:
Multi axis controller with sophisticated moves
Flexible developer's workbench

AC drive family delivers total choice:

The VersaFlex family of AC motor controls delivers state-of-the-art flexibility and economy for implementing adjustable speed industrial applications. Choice of motor control technologies, combined with modular hardware and advanced software, ensures that the optimum control can be configured for any application, whether the need is for simple regulation of motor speed, or sophisticated speed control.

The VersaFlex family includes three separate ranges of AC drive spanning open loop, encoderless vector control, and closed loop vector control technologies - with a commonality that simplifies life for OEMs and users.

Drives come with pre-programmed applications software for standard tasks. A rugged human-machine interface (HMI) provides operators with an easy means of selecting the desired mode, and also displays the status of the

control. For more sophisticated applications, the encoderless and vector variants of the drive may be configured using a Windows tool. This provides an intuitive, template-based approach to application programming, with a library of 'function blocks' that can be parameterized and interconnected in minutes using point-and-click operations. In addition to blocks for standard requirements such as ramps, speed loops and I/O control, the library includes advanced functions such as PID process control, as well as a suite of logic, arithmetic and decision operations to support complex applications programming. This flexibility allows a drive's functionality to be very closely matched to process requirements, effectively transforming the familiar adjustable speed AC motor control into a versatile platform for building custom process automation.



Drives come with built-in I/O, and can be configured with an EMC filter - with the smaller sizes capable of accommodating a built-in unit. Higher-specification drives additionally accept plug-in I/O and DeviceNet, and additional encoder inputs. The potential opened up by this hardware allows users to implement advanced control such as registration and phase-locked speed control of multi-drive systems.

NEMA motor solutions

Canada is the largest wood exporter in the world, its wood and paper enterprises working round the clock to turn out the vast range of raw and finished products vital to the country's economic health. Here, electric motors can expect torture rather than cossetting. They're really put to the test, not only in terms of their core function, but environmentally - it's by no means unusual for tree trunks to fall on the motors, for example, and equipment is continuously stressed by strong vibrations and impacts.

Guy Manuel, maintenance manager at a paper factory in Crofton, British Columbia, describes the pressure on motors in such an environment: "Our process works with aggressive chemicals, and machines must operate around the clock. Once a year we shut down for two weeks, for repair and maintenance. Outside of that, processing has to continue, non-stop. We can't tolerate longer downtimes - an unscheduled one-hour stop will cost us anything between 20 and 30 thousand dollars".

European companies seeking to sell machinery and automation equipment into this thriving market, or the equally demanding quarrying, chemicals and offshore sectors, clearly need a product

that can take the pressure. But that's not the only key requirement: for the North American user, electric motor compliance is one of the most important criteria imported machinery and equipment must fulfil.

Staff at the huge Tolko sawmill in Merritt, British Columbia point to just one example of the importance of



In paper factories, motors are treated mercilessly: mechanical damage, contact with aggressive chemicals and around the clock operation are the norm.

compliance with country standards. A 500 HP motor failed in the Tolko plant. Because a lifting eye did not fit correctly, it broke when an attempt was made to raise the motor for repair. A new eye was quickly sourced and screwed in. Again the eye ripped out of the thread - only this time the motor crashed to the ground, with costly and time consuming results.

And the cause of this waste of time

and money? The eye was machined with a national-standard imperial thread, and the IEC motor used metric threads.

This shows why component selection is critical for OEMs building for international markets. In Guy Manuel's plant, 3000 of the 5000 or so motors will be running at any one time, consuming around 140 MW of energy an hour. And every year, between 50 and 100 will fail, because of poor bearings, dirty grease or wrong shaft metallurgies - rates which are echoed at similar plants.

Enterprises like these depend on robust, reliable and the efficient machinery, and these are precisely the kind of environments and applications for which Baldor developed its Severe Duty motor series. For equipment designers in metric regions such as Europe these units are doubly valuable, because they meet all the necessary standards for export to North America: UL, NEMA, CSA and ANSI.

Baldor's motor line for these demanding requirements ranges from a half to 900 HP, with very high efficiencies, and problem-free operation at temperatures up to 200°C. Construction meets NEMA MG1 part 31.4.4.2. Thanks to double epoxy coating, Baldor even gives a warranty of three years. Guy Manuel confirms how important this is: "We expect to have motors last at least 10 to 15 years - and that includes the paint!"

Zippering through the workload

An advanced five-axis motion control system from Baldor is at the heart of the first continuous 'cross-web' zipper applicator for continuous vertical form-fill-seal and horizontal flow-wrap equipment. The new machinery for manufacturing resealable pouches - developed by Line Equipment for inserting Supreme Plastics' narrow zippers - is expected to achieve throughputs of over 80 pouches/minute, providing a breakthrough in food packaging technology.

By applying zippers across the web, food producers gain considerable packaging flexibility compared with conventional in-line zip application techniques - boosting fill ratios, saving material, and allowing one machine to be programmed for form-fill-seal operations on a much wider spectrum of pouch sizes.

To achieve continuous manufacturing, Line Equipment's innovative machine uses three zip applicators mounted on looped belts, each driven by a BSM rotary servo motor. The applicators work in a sequence: while one is applying a zip - accelerating to web speed and synchronizing with a registration mark - the next is having a zip loaded, and the third moving into the start position. A fourth rotary motion control axis feeds and cuts zip lengths into the applicators as they reach the loading point in the loop.

A fifth axis, located under the plastic web material, controls the movement of a heating element that synchronizes with the plastic web and applicator and seals zippers into place. This axis uses a linear motor, because of the sheer accelerations required to track the zipper applicator - before applying heat - and then returns to the start position in readiness for the next applicator. At 80 pouches/minute, this axis can be accelerating at rates of around 2.4G (23 metres/sec/sec).

The motion control system uses a panel-mounting Baldor NextMove BX motion controller to manage the zipper applicator and linear motor axes, plus a standalone intelligent Flex+Drive to control the zip feed and cut axis. The two motion control subsystem elements link to a Baldor operator panel using a CANopen fieldbus, which allows the operator to define zip length, pouch size, etc. Both units include the I/O required for the various sensing and actuation functions associated with the process, such as registration mark detection and zipper knife control.

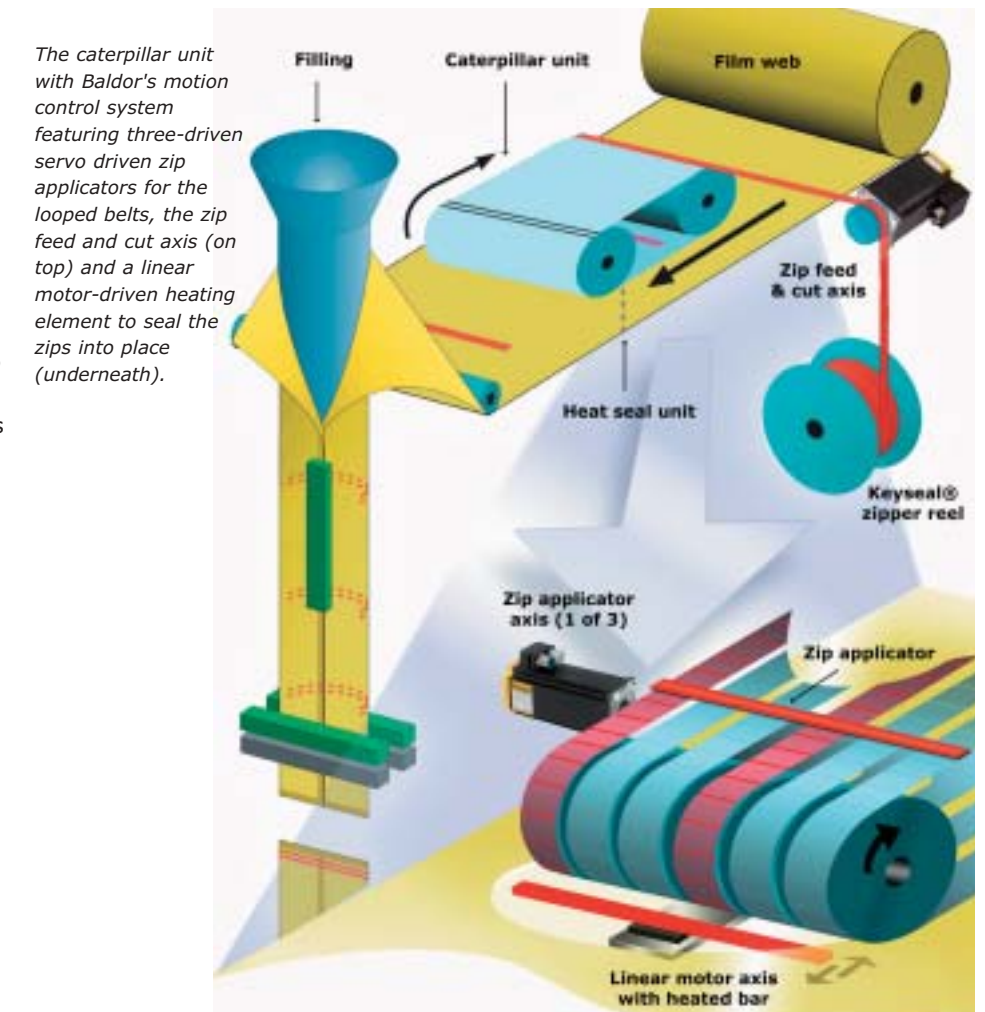
Baldor provides all motion, I/O and HMI components required for the new

machine, and wrote the application software using MintMT. Development time was greatly reduced by means of MintMT's built-in multi-tasking operating system. Baldor used this to divide the major control functions - controlling the belt and linear motor axes, and the human-machine interface - into separate tasks. This greatly simplified software development, allowing the program to be written in a couple of days, ready for download onto the prototype. With testing, the application software was produced within a week, helping to keep Line Equipment's development project on target.

The availability of application-level software in the form of keywords within

Mint also contributed significantly to fast software creation. In particular, Baldor used FLY, a high level command which will synchronize the movement of two axes while controlling the position of one - providing an elegant solution for the continuous zip attachment process. This synchronizes with the encoder on the web, so that the applicator automatically tracks the speed of the material, but it does so via a 'virtual axis', a facility in Mint that allows the machine to be set up without the master axis running - saving material.

- Application: Multi-axis precision positioning system
- Motion controller: NextMove BX II and Flex+Drive II, MintMT
- Key design advantages: High speed linear axis, Multitasking, Virtual axis capability



ProSPEC - the portal with engineering answers

ProSPEC is a web-based service for specifying and consulting engineers who are responsible for sourcing motors, drives, gears, generators and motion control. It's a 'high-value' portal designed for engineers who need up-to-date specifications and technical information. An individual can log on to access a clearing-house of information. Once there, visitors can utilize the 'Ask the Engineer' section and pose technical or general questions to Baldor engineers. Part of the service is a guarantee that questions will be answered by an engineer within one business day.

Other features include access to the most up-to-date product specs, performance data, wiring diagrams, access to noise and vibration data, technical manuals and drawing downloads. Additional features will include computer based tutorials, white papers and registration for on-site workshops.



www.baldorprospec.com

More torque, less space



BSM C-series brushless AC servo motors use ring-shaped neodymium magnets pressed onto the motor shaft, boosting magnetic flux and increasing torque by from 20 to 60% compared with the ferrite-based BSM B-series.

The magnets are so efficient that Baldor has been able to reduce the length of some motors by typically 2.5 to 5 cm (1-2 inches) - and save weight. The increased torque can translate directly into higher throughput, providing OEMs with the means to extend equipment lifecycles without costly re-design.

BSM C-series offers the same high inertias as equivalent BSM B models, providing an easy upgrade path to higher performance and compactness. BSM C-series also complements Baldor's existing N-series of neodymium servo motors, which offer low inertias for applications requiring responsive acceleration and high speeds. Together, Baldor's servo range offers a choice that allows the ideal mix of dynamic performance and inertia matching for individual precision motion axes.



FREE LITERATURE:

NextMove ESB email nextmoveesb@baldor.co.uk

MintNC email mintnc@baldor.co.uk

Mint application notes access www.supportme.net

MicroFlex servo drive email microflex@baldor.co.uk

BSM C-series brushless motors access www.baldor.co.uk/cseries.pdf

NEMA motors email motorstock@baldor.co.uk

VersaFlex AC drives email versaflex@baldor.co.uk

More information?

Motors: www.baldor.com

Motion control: www.baldor.co.uk

Motion controller data, manuals:
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BALDOR
MOTION PRODUCTS

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Meet Baldor

... at these trade shows in 2003/2004:

Drives & Controls

Birmingham, UK, June 3-5

National Plastics

Expo Chicago, IL, June 23-27

EASA

San Francisco, CA, June 29-July 2

Semicon West

San Jose, CA, July 16-18

AWFS

Anaheim, CA, July 31-August 3

Automate

Sydney, Australia, September 2-4

SPS/IPC/Drives

Nürnberg, Germany, November 25-27

Machine Building

Birmingham, UK, February 11-12 (2004)