New motion controller increases throughput in Maxi Mill upgrade

Maxi Mill end doggers (left) and chargers (center right) move the logs

The Progress team replaced the existing system with a new RMC200 multi-axis electrohydraulic motion controller from Delta Computer Systems.

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DELTA COMPUTER SYSTEMS

MAXI MILL

Maxi Mill of Albany, Oregon, makes primary breakdown log processors, called end-doggers by the forest products industry. The processors hold logs by their ends from overhead carriages (see image above), which move to carry the logs past stationary band saws that cut the logs into square cants or two-sided cants, depending on the size of the logs.

The carriage makes multiple passes based on the solution from the optimizer. In order to present each log for pickup by the carriage, it is moved into place by Y-shaped chargers. To produce the best quality cant, before the cutting begins, the log is moved to the center of the carriage at which point it is skewed right/left and up/down and rotated, based on information from the optimizer. To precisely coordinate and control the complex motion involved requires a capable multi-axis motion control solution.

The Maxi Mill hardware is robust, but after years of operation, mill control systems can often use an upgrade. Progress Engineering LLC of Manchester, Maine, has a lot of experience with retrofitting control systems for Maxi Mill equipment. A recent upgrade project for Progress Engineering involved a hardwood mill near Charlotte, North Carolina. The PLC in the 15-year-old control system had become obsolete and maintenance had become costly and time consuming because the motion interfaces were difficult to tune and control. The Progress Engineering team got involved and decided that a complete overhaul of the control system including the motion controls would provide the best results.

Whereas the end-dogger being upgraded previously had the PLC controlling all of the motion through axis interface cards, the Progress team felt that better

The RMC200 (lower left) in the new Maxi Mill control cabinet performance could be obtained by replacing that system with a new RMC200 multi-axis electrohydraulic motion controller manufactured by Delta Computer Systems of Battle Ground, Washington.

The RMC200 (see photo on the previous page) has the advantage of being able to control up to 32 motion axes simultaneously. For the North Carolina mill project, 23 control axes would be needed. Since RMC200 is expandable in increments of eight axes, 24 total axes are available in the system specified by Progress Engineering.

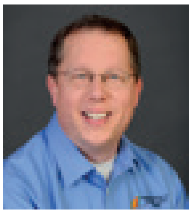
Most of the axes are used for controlling hydraulic motion actuators via proportional servo valves. This connectivity requires three SSI (synchronous serial interface) modules and three CV 8 (analog output) modules from the RMC200 product family.

"Using the SSI position inputs from linear magnetostrictive displacement transducers (LMDTs) enabled us to get position control of the system that we never had before," said Todd Bennett, Senior Project Engineer at Progress Engineering.

"And the SSI interface that Delta provides is very easy to calibrate and tune."

In addition, with SSI transducers there's no homing step needed. Therefore, if the machinery were to stop for any reason, it can resume functioning immediately were it left off.

Other axes use analog outputs,



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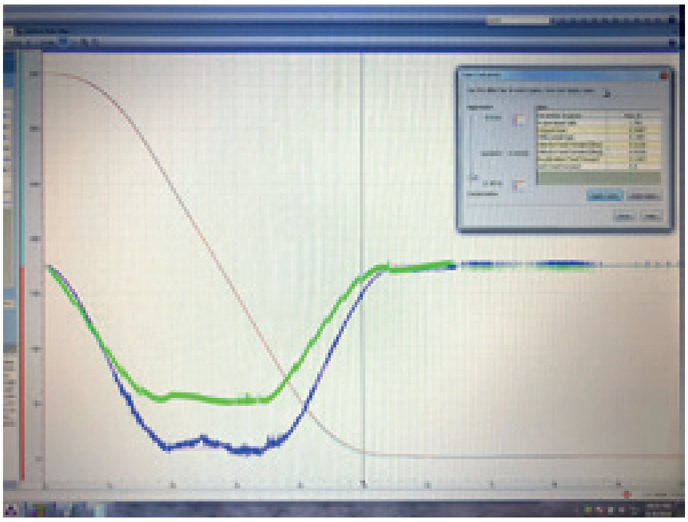

A plot made by Delta Computer Systems' Plot Manager software shows how motion parameters change over time

controlling functions such as motor speed. Finally, a couple of the axes are used to provide dogging status feedback to control decision making within the RMC.

A PLC performs overall machine control, safety monitoring and sequencing of motion steps, downloading motion commands for each axis via Ethernet communications into registers onboard the motion controller. The motion commands and status were set up in the RMC's memory using Delta's development and tuning tool set called RMCTools.

"The RMC gave us direct ramping control of the hydraulic motor speed on the outfeed rollers," said Bennett.

A lot of PLC code used to control this by issuing a series of incremental voltage changes. Now, carriage control is handled by the RMC using instructions that automatically control acceleration and deceleration. With the RMC, control is done with a simple command which replaced an analog output module in the old PLC.

"And the carriage can speed up or slow down depending on the depth of cut of the log," continued Bennett. "Without the RMC we couldn't have controlled the acceleration or deceleration as well."

To help with motion programming, tuning, and problem diagnostics, Delta Computer Systems provides a comprehensive software interface called RMCTools. The software includes an automated motion tuning tool called the Tuning Wizard that builds a mathematical model of the system, and predicts the control loop parameter gains that will produce the desired motion with minimum error due to the effects physical aspects of the system.

"I always use the tuning wizard to get me most of the way to the final gains," said Bennett. "I then use Delta's Plot Manager to fine tune the gains myself."

The Plot Manager component of RMCTools produces charts that display the values of actual motion parameters versus target values predicted by the control loop algorithm. Shown above is a screen image generated by the Plot Manager that shows the position of the overhead carriage (the red plot line), the velocity of the carriage (the blue line), and the control output to the DC motor that moved the carriage (the green line).

When tuning the system, the engineer can make changes to parameter gains in the PID loop and see the effect of the changes in the actual motion.

"It's much easier to diagnose problems using the graphs rather than simply watching the machinery operate," said Todd Bennett. "Last year we used the plotting function to discover that some vibration in the operation of the carriage was due to a loose mechanical coupling to one of the machine sensors.

"This was the first time that a Maxi Mill has had an entire control system upgrade with an RMC200," said Bennett. "And, so far the results have been exceptional. With the improved carriage control, accuracy has improved, calibration time has been reduced, uptime has improved, and the throughput of the line has increased as much as 15%."

Axis	Transducer Type
1. Horiz. Charger #1	SSI position inputs
2. Horiz. Charger #2	SSI position inputs
3. Horiz. Charger #3	SSI position inputs
4. Horiz. Charger #4	SSI position inputs
5. Vert. Charger #1	SSI position inputs
6. Vert. Charger #2	SSI position inputs
7. Vert. Charger #3	SSI position inputs
8. Vert. Charger #4	SSI position inputs
9. Left Bandmill	SSI position inputs
10. Right Bandmill	SSI position inputs
11. Left Saw Guide	SSI position inputs
12. Right Saw Guide	SSI position inputs
13. Left Outfeed Near	SSI position inputs
14. Left Outfeed Far	SSI position inputs
15. Right Outfeed Near	SSI position inputs
16. Right Outfeed Far	SSI position inputs
17. Main Carriage	SSI rotary encoder inputs (DC Drive)
18. Inner Carriage (Rear dog)Drive)	SSI position inputs
19. Front Dog Rotate	SSI position inputs
20. Rear Dog Rotate	SSI position inputs
21A. Front Dog Pin	SSI feedback only (solenoid activated)
21B. Left Outfeed Roll Hydraulic Motor	Analog outputs (+/-10V only)
22A. Rear Dog Pin	SSI feedback only (solenoid activated)
22B. Right Outfeed Roll Hydraulic Motor	Analog outputs (+/-10V only)
23A. Spare SSI	
23B. Dogging Pressure reducing valve	Analog outputs (+/-10V only)
24A. Spare SSI	
24B. Spare Analog	

RMC200 axis allocations. Axes 1-16 and 18-20 incorporate position feedback from linear magnetostrictive displacement transducers (LMDTs)