Distribute and conquer: Ethernet tackles motion control

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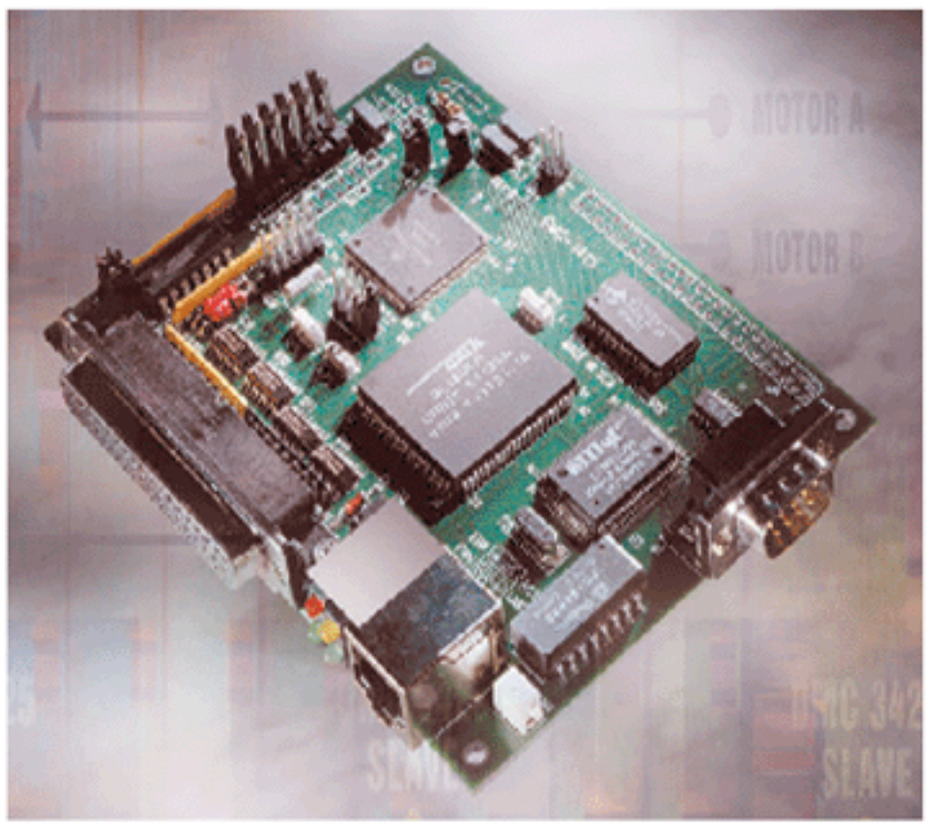
Traditionally, motion-control system architectures have fallen into two camps: central and distributed. A new Ethernet-based approach can't be categorized as either one. It overcomes the limitations of both architectures while combining their best features.

In a typical central control system, a single motion controller sits on an ISA or PCI bus in a PC. This is a fairly simple approach by which the controller communicates with the host computer via the system bus. One downside of this approach is that each motion control component (motor, encoder, limit switch) connects to the central controller via wires that can be hundreds of feet long. Of course, long wire runs can be costly and raise the possibility of noise interference

A distributed-control system overcomes the excess wiring problem by placing a single-axis controller close to the motor. Each controller is then wired to a bus network. But it becomes more difficult for the PC to keep track of all the controllers, as the necessary programming is relatively complex.

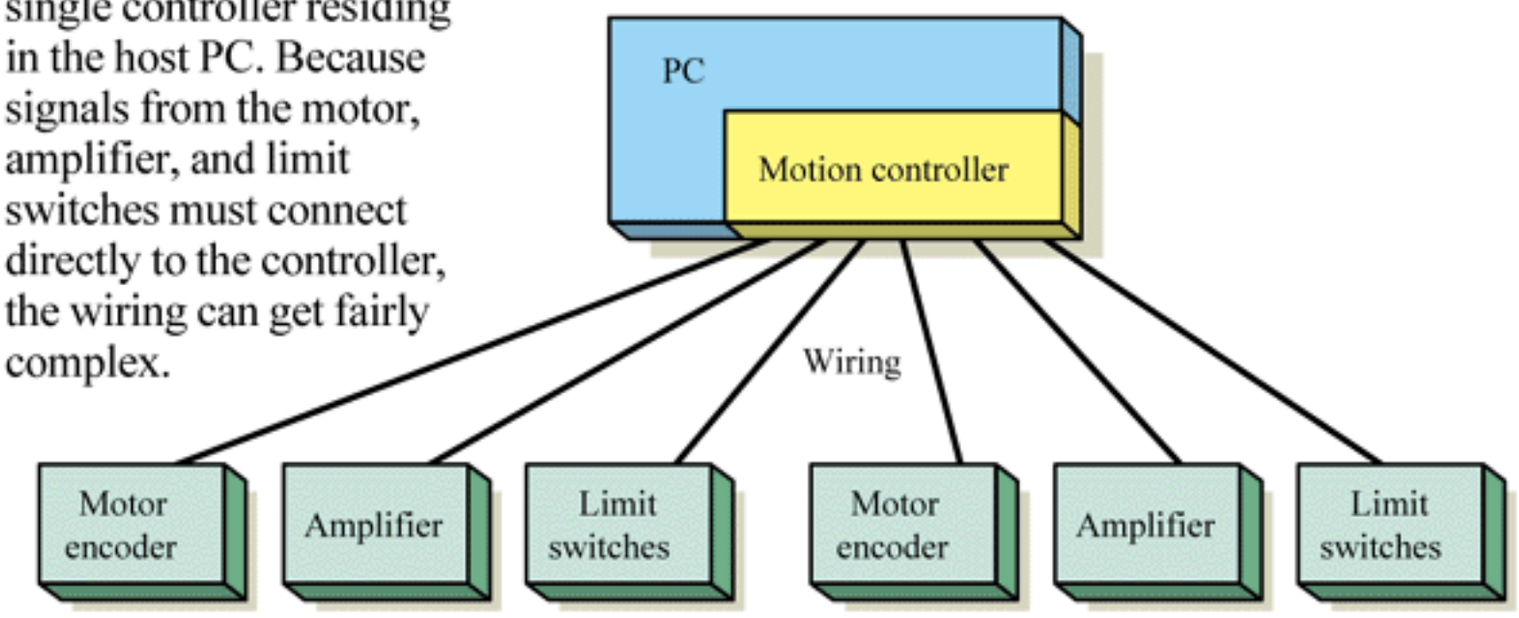
Ethernet-based control architectures offer a third way. An Ethernet-based motion-control system consists of a host computer, an Ethernet hub, and several motion controllers. The wiring is minimal because individual controllers can sit next to the motors and amplifiers. Also, fiber optics used for communication can eliminate noise coupling and grounding problems completely. Ethernet TCP/IP protocol is also more flexible, so additional devices easily



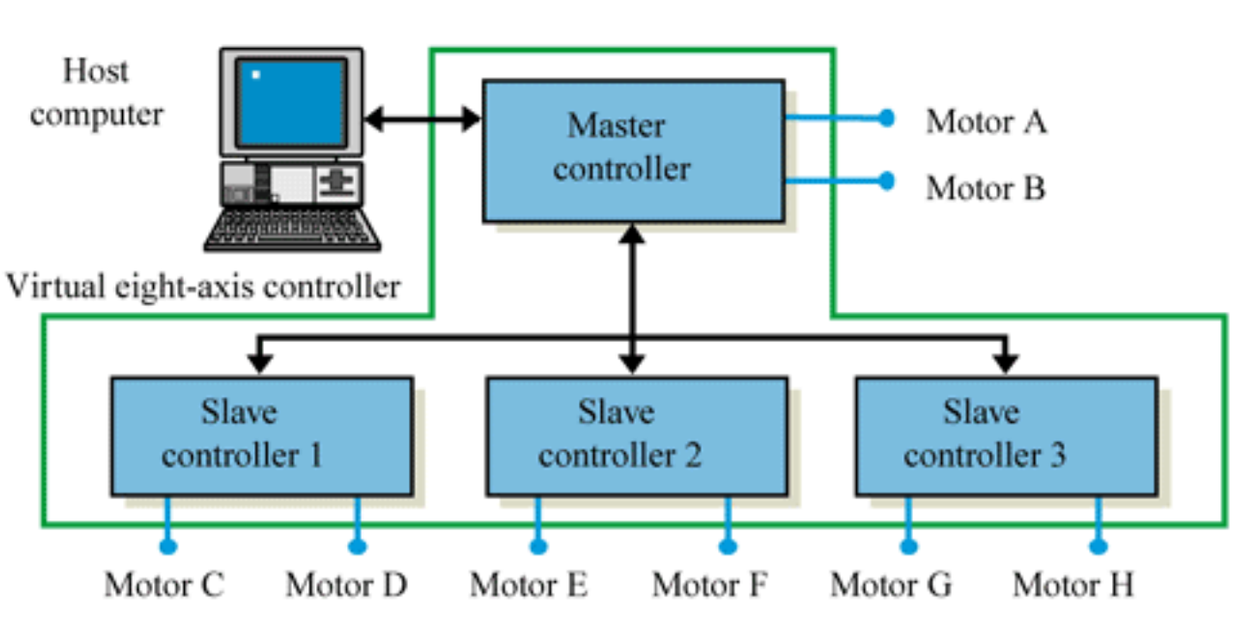
The DMC-3425 from Galil Motion Control Inc., Rocklin, Calif., the first controller in its E-Series, is a two-axis, Ethernet-based motion controller. It provides precise control of servomotors and includes both linear and circular interpolation algorithms in addition to PID filtering with notch and feed-forward parameters.

A typical central control system consists of a single controller residing in the host PC. Because signals from the motor, amplifier, and limit switches must connect directly to the controller, the wiring can get fairly complex.

Central control system



Ethernet-based distributed control



E-Series motion controllers use Ethernet as the basis of the network and system elements. One controller serves as the master that receives all commands from the host computer. It then passes commands to slaves, each of which can control two axes of motion.

connect to the network. Readily available system components such as Ethernet cards and hubs keep costs down as well.

One disadvantage to the Ethernet-based approach is that the requisite computer program is complex. The reason is that it must handle communications with several devices simultaneously.

E-Series motion controllers are Ethernet-based, yet have qualities of a central control-system. One controller is designated as the master. It controls two motors and all remaining controllers, designated as slaves. For the purpose of control and communication, the master acts as a virtual multiaxis controller. This means that the host computer need only communicate with the master controller to give it commands for all the axes. It is then the responsibility of the master to inform the slaves about their respective tasks. The master also holds all the data about the slaves, and the host can interrogate it about the status of any axis. ■

Tanks a lot — PLC is a key to talkative tank filling system

Operators don't have to worry about keeping an eye on new Sur-Fill systems, used to fill gas cylinders. The Q Processor platform from Mitsubishi Electric Automation lets the system issue prompts in a human voice. It can even remind forgetful operators and warn them of impending events.

A prerecorded voice chimes in with messages like "Time for your PS 1000 leak check," or, "Approaching your pressure" as these events grow near. "This way the operator doesn't have to stand there and watch the filling process," says Gary Schueman, principal of Computer Integrated Automation Inc. CIA Inc. (Carol Stream, Ill.) working with Weldcoa, a maker of cylinder handling and filling gear in Northlake, Ill, devised the Sur-Fill system. "We've had customers that were able to reduce their labor force just because of the prompting feature," says Schueman.

Inside the vibrationproof cabinet of this Sur-Fill single gas system (right) are sample cylinders on scales. A Mitsubishi A-500 frequency drive controller in a NEMA enclosure to the rear of the system (left) reads the weight measurements for turning gas and vacuum on and off, and for operating pump motors. Operators interact with Mitsubishi A-900 a touch screen incorporating 3D graphics. The touch screen is on the control cabinet front panel.

One reason for the use of the Mitsubishi PLC was "I had worked with many different types of automation controls over the years and knew I wanted to avoid a PC-based platform," says Weldcoa senior R&D developer Maynard Klotz. A Mitsubishi Q Processor platform got the nod for its dual high-speed Risc processors and 0.15 □sec/step execution speeds. Says Schueman, "The Q processor option is probably the fastest high-end PLC on the market right now. Its floating-point abilities and ease of programming with high-level commands are what makes the gas system possible."

Sur-Fill operators first weigh spent tanks that have been returned. The measurement gets checked against a database to find out what the particular tank should weigh when completely empty. Any foreign matter in the tank raises a flag. The system evacuates it before refilling to prevent any contamination.

The system can fill cylinders with gas to a proscribed weight, or with specific mixtures of gases based on their individual pressures. The latter process is complicated by the increases in gas temperature that accompany rising pressures. To that end, gas physicists at CIA Inc. devised filling algorithms that factor in heat of compression. They let the Mitsubishi controller compute shut-off pressures for each gas going into the mixture so that the final cylinder pressure is correct.

Under control of the Mitsubishi controller, the system can fill as many as four manifolds simultaneously each holding 16 300-ft ^{3} tanks. Mitsubishi A-500 variable-frequency drives power the pump motors. Alarms signal the detection of failure in system components such as thermocouples or pressure transducers. ■