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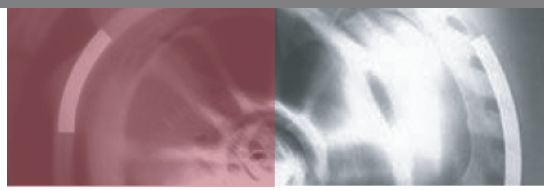

The Next Generation of Smart Heads

The Next Generation of "Smart Heads"

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Most machine designers now are counting on distributed motion control (DMC) architectures for assembly of new products for persuasive reasons: increased reliability, lower cost and reduced time to repair.

Whether surface mount equipment is mounting integrated circuits (IC), dispensing materials or stencil printing, motion control always has been a critical part of the design. Now, however, a transition from centralized motion control subsystems to DMC is beckoning assemblers. While throughput is a critical metric for any machine, with DMC, OEMs can take advantage of motion control subsystems that are tailor-made for surface mount assembly.

Existing Equipment Limitations

A typical machine has moving heads on a gantry. They feature motors, digital input/output (I/O) and sensors. The motors require wires to power their windings and to return the position feedback to the controller and, for some systems, wires for the hall-effect (magnetic) sensors. There are wires for each I/O point and for each sensor. And all must run a few meters back along the gantry in cable trays. Thus, with high-speed systems, the weight of the cables themselves is a limit to system performance. And in the field, a further drawback is evident: the sheer complexity of the cable systems is a burden if there is need to repair or replace a component in the system quickly. Also, because the cables must withstand repeated flexing and bending, they frequently cost more than the devices to which they are connected.

In contrast, with DMC the position controller is placed next to the servo amplifier (in some cases the two are combined), removing the intelligence for control from the motors. Additionally, complicated cabling is eliminated and noise reduced, resulting in a reliability upgrade as well as lowered cost.

Traditional servo systems often consist of high-performance host computers that communicate with multi-axis-motion controller cards and interface with a number of drives or amplifiers that typically have their own high-end processors on board. In numerous cases, the level of such communication can be broken into three categories, each requiring different features and functions from the distributed servo controller-amplifier:
Simple point-to-point moves with non-critical trajectories
Moves requiring coordination and blending (with trajectory generation tied to the motion of the machine)
Complex moves with trajectories critical to the process or machine.

SMT assembly typically is in the first category with point-to-point moves that, though simple, are demanding in their requirements for event-triggered motions at extremely high speed.

It is possible to envision two types of distributed servo controller/amplifiers for point-to-point moves with non-critical trajectory applications: 1) those for repetitive point-to-point movements with external event-generated conditions, and 2) others for point-to-point destinations that vary based on user- or machine-generated events. The requirements for a distributed servo controller/amplifier involve the determination of a trajectory based on current location and a requirement of either a user or a preprogrammed destination. Effectively, the only user requirement is to set acceleration, velocity, jerk parameters (for S-curve) and a series of final points.

Integrated DMC

With DMC, manufacturers can mount the motion controller and servo amplifiers directly in the gantry on the component mounting heads. This results in a wiring harness of reduced complexity and associated electrical noise. By increasing the number of power stages on the head, the unit can drive more than one motor, limited only by the processing power of the controller's computer. Figure 1 shows the motion controller and servo amplifiers integrated in the gantry directly on the heads, as a distributed solution to motion control.

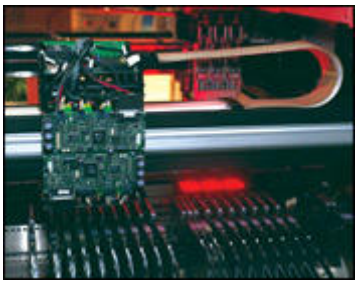

Figure 1. Close-up of a motion controller and servo amplifiers as integrated in the gantry directly on the placement heads — a distributed solution to motion control.

To implement a distributed-servo-controller/amplifier, the module must meet the basic system requirements:

- Processing power to control all aspects of a multi-axes move
- Fast and determined communication between the host computer and the servo controller/amplifier, as realized in an integrated module with small size and low mass.

Of course, market acceptance of this approach also demands that the DMC solution be reliable and economically viable, which now is possible.

Application Brief

Figure 2 compares a traditional centralized motion control system to an integrated, multi-axes DMC module that combines both the drive and motion control functions into a single compact package.* (In a third-generation version of the concept, the module controls and drives up to four brushless DC motors with multi-power ranges.) With the encoders, hall-effect sensors, multiple user I/O and limits connected directly to the amplifier-control network, the only external requirements are network cable for determined communication and a DC power source.

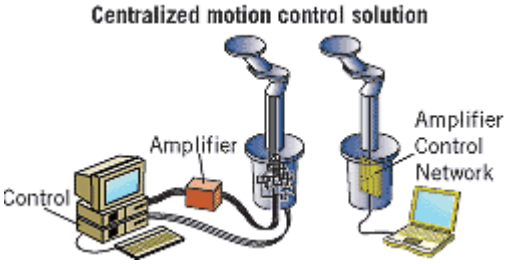

Figure 2. An integrated, DMC package is compared to a traditional centralized system. The module combines both the drive and motion control functions with a resulting reliability upgrade.

Embedded into the DMC are the current and position loops as well as an application layer for network interfacing. Onboard S-curve trajectory generators are used for point-to-point applications, and PVT (position, velocity, timing set points) streaming is available for complex and coordinated trajectory applications. Lastly, macros in flash memory provide the ability to execute extensive stored sequences of motion, I/O and event-based motions critical for pick-and-place operations.

In one example, the new DMC enables a chip placer to mount the pick-and-place mechanisms entirely on heads that move on multiple gantries inside the system. By combining the amplifier and controller in a 3.0 x 8.0" package, each motion control unit integrates the three axes of control with three 400 W, integrated servo amplifiers, permitting reduced wiring, increased reliability, decreased noise susceptibility and increased diagnostics visibility.

Looking Forward

As automation and assembly OEMs continue dealing with shorter time-to-market demands and ever increasing performance and quality standards, motion control subsystems will continue to be pushed to viable creative alternatives.

Advancements will accelerate with continued innovation, which, at this point, would be supported best through DMC integration solutions.

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