Motion control considerations for Robotics

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The rates at which physical robots are integrating into society today has increased so much that new categories are being created for their use and general purposes as well as dedicated designs versions compete for acceptability. The future of robots and robotics technologies is an economic area where it can be projected that new companies with new achievements will be some of the largest in the world in a short period of time. Intelligence is key to robots but what makes robots move so they can accomplish the activities they are designed to do is vital to their performance, and ultimately their existence. This brief article introduces the many aspects of motion control needing consideration when applying drive technology to robotic systems and platforms.

Any mechanical object that moves generally has a motor for operation. The electric motors incorporated into robotic designs are based on needed torque/force, speed and acceleration/deceleration parameters and are typically going to be either servos or steppers. In industrial robotics platforms, each motor selected will have a controlling drive that operates the motor to ensure required performance. By design and construction of each, servo systems are much more efficient than steppers and offer a much wider operating range. As servo drives are more widely used and accepted, the focus here will be on servo-based motion control.

Robots can have many different axes needing motion control and likely will include more than just main mobility of either propulsion or traction. For instance, there can be separate steering, arm extension/retraction, gripping, joint rotation, lifting, haptic feedback, etc. All of these functions usually incorporate a drive specifically tuned for that axis to provide the necessary controlled motion. The drives themselves receive commands from a supervisory controller that also maintains overall functionality of the entire system/platform. Motion control for the entire robotic system has traditionally been categorized into two areas: centralized or distributed.

A centralized control scheme requires the controller to continually calculate all torque/force, speed and position commands (called the control loops) for every axis, while simultaneously running complex programs that pla
motion profiles but also scan I/O or vision
maintain complete robot operations. This can
burden on the processor(s) selected for use an
system unmanageable when increasing scalabil

In distributed control systems, motor contr
are placed with the drives themselves and conc
work communications where the controller n

activities of the drives with limited computation needed. This allows the controller to operate more effectively and be more available for all other system functions. There are numerous networks to choose from as well as standardized function calls allowing motion control and system functionality to work very closely together. CANopen, EtherCAT, Modbus, Ethernet POWERLINK, PLCopen, etc. offer fully documented methods of getting up and running quickly and greatly reduce development time.

As robots need to manage on-board power as much as possible for continued operation, the choice for servo drives is wise as they are most efficient. This includes a power range from 10Watts to more than 50kW! However, and along with the servo motors, drives need to be 'sized' appropriately. Since the robot will have a pre-established voltage level available to the drives, sizing relates to being able to provide the minimum current required to allow the motor to maximize its abilities. As well, drives are offered in various platforms to include available back-plane mounted and PCB plug-in module versions, both with standard and extended environment capabilities. Custom designs are also available allowing robot OEMs to 'think outside of the box'. Custom engineered designs provide the prospect of achieving results not otherwise possible and often at costs less than that of off-the-shelf designs.

This information and insight has provided many industries with application excellence using servo driven robots and robotic platforms. For example: Material Handling's - Palletizers, Sorters, Automated Fork Lifts; Warehousing's - Storage & Retrieval Systems, Automated 'Pick & Present' Systems; Manufacturing's - Automated Guided Vehicles (AGV's), Transfer Lines, Assembly Cells; Medical's – Surgical, Scanning Systems; Homeland Security and Defense's: Unmanned Vehicle Systems (UVS's) for Air, Ground and Submersibles, Remote Control Detection; Service's – Telepresence, Inspection, Repair and Delivery.

Many more robots exist and many more are coming. Stay tuned to what the future holds…