Motion Control Standards

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Why are standards important?

- Ensure consistency of implementation
- Reduce effort in development
- Reduce errors in implementation
- Capturing organizational knowledge
- Simplified procurement process
- Provide a single source of information
Motion control standards

- Coordinate system definition
- Interface definitions
- Hardware standards
- Cabling standards
- Programming standards
Coordinate system definition

Figure 1: Mirror coordinate system example
Coordinate system definition

- Define standard for x, y, z axis directions
- Define standard for rotations: refer to rotation around x, y, z or pitch, roll, yaw?
- Use right-handed or left-handed convention?
- Consider optics orientation
  - vertical and horizontal orientation
  - reflection direction
  - transmission optics
- Define what is positive
- Decide if positive/negative definitions can change at different levels in control system:
  - physical
  - low level controls
  - user controls
- Identify any special cases and exceptions
Interface definitions

- Identify common instrumentation interfaces at equipment and control rack locations
- Define connector types for each part of the connection
- Define pinouts for each cable
- Consider using common conventions, either from other facilities or manufacturers
- Select connector gender to avoid live pin contacts
- Select connectors to avoid possibility of accidental incorrect connections
- Define use of patch panels at equipment end and rack end
- Provide clear scope for vendors who are developing equipment
Motion control hardware definitions

- Define standard components to be used on equipment
  - Motors (type, manufacturer)
  - Encoders (absolute or incremental, protocol, manufacturer)
  - Switches (limits, overtravels, datums)
- Define standard motion controller(s)
- Define standard motor drives
- Identify areas where non-standard controllers can be used
- Power supply standards for motor controllers and amplifiers
- Rack standards
- Rack layout standards
Cabling standards

- Provide specification for standard cable functions
  - Motor cable
  - Encoder cable
  - Limit switch cable
  - General IO cable

- Identify conductor size, count, pairing, insulation and jacket colour, shielding

- Consider any local electrical standards - insulation requirements, jacket materials (e.g., low-smoke, zero halogen)

- Decide if commercially available cables can be used or if custom cables are needed

- Cable weight, bending radius

- Capture information in drawings, tables, documents
Motion controller programming standards

- Used for advanced programmable motor controllers
- Allocate motor controller resources for standard functions
- May be dictated by control system software interface (e.g., EPICS motor record driver for Delta Tau PMAC)
- Identify controller resources that can be used for custom applications
- Create a standard configuration for use as a starting point
- Programming standards will be specific to a controller model
Thank you
Other things to consider

- Standards can develop over time
- Backwards-compatibility is important
- Someone needs to own the standards
  - Definition
  - Maintenance
  - Implementation
- Definition of standards can come from a range of sources
  - Other facilities
  - Users and staff
  - Legal and regulatory requirements
  - Vendors and manufacturers
  - Existing organisational standards

The only thing worse than a bad standard is no standard at all.
Who will use the standards?

- Facility staff
- Vendors
- Partner developers - external user groups
- Other facilities - use as starting point for development