Motion Control

Course 705 – 32 Hours

Overview
This Motion Control course is designed to integrate the related engineering fields which share the outcome of every typical motion control system: system engineering concepts, electrical machinery and drives, power electronics, feedback devices technology and control theory. The practical nature of the course provides a focused, yet comprehensive and multidisciplinary overview of the main analysis and design methods of motion control systems.

Course Objectives
The objective of this industry oriented course is to provide the core knowledge and the practical aspects of motion control analysis and design methodology in terms of: system topology, feedback devices, motor sizing, mechanical transmissions, power amplifiers, and PID control and system analysis.

Who Should Attend
The course is mainly adequate to engineering staff involved in design and development of motion control systems. Support staffs (maintenance & service, sales, etc.) are encouraged to attend the course as a unique source to broaden their professional background.

Prerequisites
Basic background in mechanics, electrical theory, control theory (graduate level).

Course Contents

System Engineering in Motion Control

- Motion Control Architectures and Solutions
- Review of Closed Loop Control Benefits and Limitations
- Motion Control Performance Criteria
- Motion Control System Modeling
- Error Budgeting
- Motion Profiles
- System Level Control: Centralized vs. Network Control
- Motion Control System Development Road Map

Motion Control Technology: Motors

- Brush Type DC Servo Motor
- Brushless DC Servo Motor

- Torque Ripple
- Torque Motors
- Motor Commutation Solutions: trapezoidal (six step), sinusoidal and vector control
- Linear Force Motors
- Phase Advance for high speed motor control
- DC motor modeling
- Reading the DC Servo Motor Specifications
- Power Amplifiers Architecture for DC Servo Motors Control
- Step Motors: Types and Operating Principles
- Commutation Control of Stepping Motors
- Using the Step Motor specifications
- Resonance and Micro stepping Control
- DC Motor Control Integrated Solutions
- Step Motor Control Integrated Solutions

Motion Control Technology: Feedback and Mechanical Devices

- Resolvers and R2D conversion
- Incremental Optical Encoders
- Absolute Optical Encoders
- Optical Linear Scale
- Magnetic Encoders
- Mechanical Devices in Motion Control: gearing, lead screw and belt drives solutions
- Motion Control Dynamics for Gear Drive: kinematics and torque conversion
- Motion Control Dynamics for Lead Screw Drive: kinematics and force conversion
- Motion Control Dynamics for Belt Drive: kinematics and force conversion
- Mechanical Natural Frequency vs. servo bandwidth requirements
- Duty Cycle and RMS value of motion profile
- Thermal Management in Motion Control Applications
- Motor Sizing Procedure for Motion Control Applications
- Gearing Sizing Procedure for Motion Control Applications
- Power Amplifier Sizing For Motion Control Applications
- Voltage and Current Requirements

Control Theory in Motion Control

- Generic Structure of Motion Control Systems

- Velocity and Position Control
- Current control benefits in DC servo Motor control applications
- Inner (Derivative) Loop Benefits
- LEAD/LAG Control
- PID Control
- Non Linear Control
- Digital Control Solutions in Motion Control Applications

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