PRACTICAL
MOTION CONTROL
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Design and troubleshoot a complete motion control system
- Apply new knowledge of servos to motion control applications
- Troubleshoot servo systems
- Size and select the appropriate drives/amplifiers/servos/ steppers for your application
- Apply the concepts of load, inertia, force and real time to motion control problems
- Understand concepts such as backlash, static/running friction, resolution, stiffness, speed and torque
- Design and troubleshoot six basic motor types for motion control

WHO SHOULD ATTEND:

- Control and instrumentation engineers and technicians
- Instrumentation and control engineers/technicians
- Electrical engineers
- Process control engineers
- Electronic engineers
- System integrators
- Designers
- Design engineers
- Systems engineers
- Test engineers

Petra Training Group

The Workshop

This workshop is designed for personnel who need to apply motion control technology as productively and economically as possible.

This practical course initially examines the basic building blocks and design tools to implement motion control systems. Fundamental concepts of load, inertia, force and real time will be discussed.

The various factors such as performance limitations and costs that impact the selection of electro hydraulic, pneumatic, electromechanical technologies are discussed.

Servo basics are then examined in considerable detail giving you the practical tools in which to work with these systems.

The electrical and mechanical characteristics important in tying together the drive and motor to the mechanical device are then reviewed from a practical perspective.

The basic motors used in motion control such as DC and AC motors, stepper and servo motors and their applications, are also examined. These motors range from small instrumentation motors to robust AC induction motors and to the stepper motors used in open loop control.

Pre-requisites

A basic working knowledge of electrical engineering concepts is useful but not essential as there will be brief revision at the commencement of the class. Please don't forget to bring a scientific calculator!

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

The Program

FUNDAMENTALS OF MOTION CONTROL
- Definition of motion control
- Fundamental concepts
- Engineering practices and techniques

MOTION CONTROL TECHNOLOGIES
- Hydraulics
- Pneumatics
- Electromechanical
- Mechanical

MOTION CONTROL SYSTEM LOOPS
- Open and closed systems
- Block diagrams
- Implementation of a control system
- Event controlled systems
- PID controls

SELECTION OF THE FEEDBACK
- Analog vs digital and incremental vs absolute feedback
- Resolution and bandwidth considerations

PHYSICS OF MECHANICAL LOADS
- Brief overview of concepts

MECHANICAL TRANSFORMATION DEVICES
- Reflecting loads through the transformer
- Other transforming devices
- Gears
- Conveyers - elevators
- Inertia at the shaft
- Belts and pulleys

NON LINEAR LOAD TRANSFORMATION
- Equivalent mass
- Mass polar moment of inertia
- Parallel axis theorem
- Spring-inertia resonance method of determining inertia empirically
- In position holding force load resonance

LOAD/SYSTEM ANALYSIS
- Motor/load considerations
- Stability/bandwidth considerations
- Inertia calculations
- Estimating design alternatives
- PWM vs analog vs linear

SERVO BASICS
- Basic gain equations
- Selecting system components of a servo system
- Criteria for motor
- Criteria for amplifier
- Criteria for encoder
- Criteria for coupling
- Criteria for controller
- Command generation
- Feedback
- Type 0,1, 2 servos
- Bode diagrams made easy
- Predicting servo response
- Characteristics of a motor for servos

SERVO RESPONSES
- Sinusoidal inputs
- Step inputs
- Performance prediction
- Importance of gain setting
- Feedforward
- Type 2 systems
- PID in a servo
- Stability criteria in a servo
- Load effects on stability
- S curves and their application

INTRODUCTION TO BASICS OF DRIVES
- DC/AC - analog/digital
- Drive classifications
- Drive motor characteristics
- Drive motor equations
- Amplifiers and types
- Compensating techniques
- Drive speed and acceleration
- Drive thrust and torque
- Drive inertia considerations
- Drive ratios

ADVANCED CONSIDERATIONS OF DRIVES
- Performance, stiffness, resolution, friction
- Duty cycle
- Drive sizing

OPERATION OF ELECTRIC MOTORS
- Types of motors
- DC motors (permanent/armature/field/ commutation/brush vs brushless)
- AC motors (induction/synchronous/ universal)
- Stepper motors (indexers/sequencers/ microstepping)
- Miscellaneous types
- Characterising motors (torque-speed/ data sheets)

MOTORS
- Brush AC motors
- AC induction motors
- Brushless DC motors
- Stepper motors
- Linear motors: commutation, performance, figures of merit, data sheets, motor drivers, applications

MULTI AXIS CONTROL
- Splines, circles and linear motion co-ordination
- Multi axis data handling - software

LATEST DESIGN APPLICATIONS AND TECHNIQUES
- Solving your real time systems motion control problem
- Position control
- Linear motion and circular motion
- Master/slave control
- Electronic gearing
- Dual loops to eliminate backlash
- Tension control systems

SUMMARY, OPEN FORUM AND CLOSING

Petra Training Group