Data Acquisition Systems (DAQ): Signal Conditioning, Graphical Programming and Test Automation

19 – 23 April 2027
London - Central London four-star



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Introduction:

Data acquisition systems sit between a physical test and every decision taken from its results, yet many rigs log aliased waveforms, unbalanced bridge readings or unlabelled files that nobody can trace back to a sensor. This Core Concept course takes test, laboratory and R&D engineers through the full DAQ chain: transducers, signal conditioning, analogue-to-digital conversion, sampling, graphical dataflow programming, instrument control, data logging, signal analysis and chain validation. Participants produce a DAQ and Test Automation Application Design for a case test rig, ready to build and verify.

Course Objectives:

- Specify a DAQ chain from transducer to host software against channel count, bandwidth, range and accuracy requirements
- Configure amplification, bridge completion, isolation and anti-aliasing filtering so each channel reaches the ADC within its input range
- Select sample rate, resolution and acquisition mode that capture the signal without aliasing or wasted storage
- Build acquisition and test sequencing code with graphical dataflow programming, loops, arrays and state machines
- Automate bench instruments over serial and bus interfaces and log results in traceable file formats
- Validate and calibrate a DAQ chain and analyse acquired waveforms with FFT and digital filtering

Target Audience:

- Engineers responsible for designing and running mechanical, electrical and environmental test rigs
- Laboratory engineers responsible for measurement set-ups, bench instruments and results records
- Instrumentation engineers responsible for sensor wiring, signal conditioning and channel checks on test benches
- R&D engineers responsible for prototype characterisation and experiment data capture
- Test engineers responsible for automating repetitive product and component tests

Course Outline:

Day 1: DAQ Chain Architecture and Transducer Selection

- DAQ Chain Architecture: Transducer, Signal Conditioning, ADC and Host Software
- Plug-In, Modular Chassis, Networked and Standalone Data Logger Hardware Options
- Transducer Selection: Thermocouples, Strain Gauges, Accelerometers and Load Cells
- Single-Ended, Differential and Pseudo-Differential Input Wiring and Ground Loops
- Measurement Requirements Sheet: Channel Count, Bandwidth, Range and Accuracy Budget

Day 2: Signal Conditioning, Sampling and Analogue-to-Digital Conversion

- Amplification, Sensor Excitation and Linearisation Stages Ahead of the ADC
- Wheatstone Bridge Quarter, Half and Full Configurations with Dummy Gauge Compensation
- Magnetic and Optical Isolation for High Common-Mode Voltage Channels
- Nyquist Rate, Aliasing and Analogue Anti-Aliasing Filter Cut-Off Selection
- ADC Resolution, Input Range, Code Width and Multiplexed Versus Simultaneous Sampling

Day 3: Graphical Dataflow Programming for Acquisition

- Dataflow Execution Model: Nodes, Wires and Data Dependency
- Front Panel Controls and Indicators Versus Block Diagram Code
- While Loops, For Loops, Shift Registers and Array Handling of Waveform Data
- Finite, Continuous and Triggered Acquisition Tasks with Buffered Reads
- Digital I/O Lines, Counter Edge Counting, Frequency and Pulse Width Measurement

Day 4: Test Automation, Instrument Control, Logging and Signal Analysis

- State Machine and Producer-Consumer Design Patterns for Test Sequencing
- Instrument Control over RS-232, USB, Ethernet and IEEE 488 with SCPI Commands
- Data Logging to Text, Binary and Hierarchical Formats with Metadata Headers
- FFT Spectrum, Windowing and Digital Filtering of Acquired Waveforms
- DAQ Chain Calibration and Validation: Signal Injection, Offset, Gain and Noise Floor Checks

Day 5: Capstone Lab: DAQ and Test Automation Application Design

- Case Test Rig Brief: Structural Load and Vibration Test Specification
- Channel Map, Conditioning Choices and Sample Rate Justification
- Application State Diagram, Error Handling and Operator Front Panel Layout
- Logging Scheme, Automated Test Report Generation and Pass-Fail Limits
- DAQ and Test Automation Application Design Review and Peer Challenge

Skills You Will Gain:

- Transducer Selection
- Bridge Circuit Configuration
- Anti-Aliasing Filter Design
- Dataflow Programming
- Acquisition Task Configuration
- Bench Instrument Automation
- Test Data Logging
- Spectral Analysis

Why Attend This Course:

- Return with a DAQ and Test Automation Application Design for a case test rig, covering channel map, code structure and logging scheme
- Stop losing test runs to aliasing, clipped channels and unbalanced bridges by setting conditioning and sample rate from the signal itself
- Replace manual bench readings with automated instrument sequences that write labelled, traceable result files
- Compare rig and laboratory practice with engineers from automotive, aerospace, energy, electronics and research settings

Conclusion:

A test result is only as sound as the DAQ chain behind it: the transducer, its conditioning, the sample rate, the code that sequences the test and the file that records it. The course moves from chain architecture and transducer choice through bridge circuits, isolation, sampling and conversion, into graphical dataflow programming, counters and digital I/O, then instrument control, logging, spectral analysis and chain validation. The final day turns this into a DAQ and Test Automation Application Design for a case test rig.