QUANSER
INNOVATE·EDUCATE

QUANSER PRODUCTS AND SOLUTIONS

From Classic Control to Complex Mechatronic Systems Design

made|for|science
we help to find

www.made-for-science.com

YOUR FIRST CHOICE
FOR CONTROL SYSTEMS EXPERIMENTS

For twenty five years, institutions around the world have chosen Quanser equipment for their control systems education and research. Renowned for the innovative design, robust quality, and complete line of accessories and resources, Quanser provides cost-effective platforms that put your teaching and research ahead of the pack.

GIVE YOUR UNDERGRADS THE BEST IN TEACHING LABS

Whether you want to stress fundamental control concepts, or motivate your students through engaging hands-on application experiences, Quanser provides complete, student-friendly hardware, software, and courseware to build a world-class lab. This means you spend less time and energy on course preparation and student support as you introduce your students to critical, industry-ready concepts and techniques.

ACCELERATE YOUR RESEARCH

Offering the broadest range of motion platforms and plants, Quanser provides a highly efficient real-time control platform to develop sophisticated control strategies and validate your algorithms. Quanser equipment have been at the core of countless research projects ranging from fundamental theoretical control, to modern applications such as haptics, teleoperation, robotics, and unmanned vehicles.

INTRODUCTION TO CONTROL SYSTEMS

Introduction to Control Systems is a typical core course in the engineering undergraduate curriculum in Electrical and Computer Engineering, Mechanical Engineering, Aerospace Engineering, and Chemical Engineering. Quanser plants offer the right mix of features, precision, robustness, and flexibility for a wide range of course variations and budgets. Our range of servomotor-based experiment options allows you to select products that best support the fundamental concepts taught in your introductory course, including motor characterization and modeling, velocity control, position control, PID control and more.

Most systems come with comprehensive ready-to-use courseware that allows you to quickly incorporate the plants into your course.

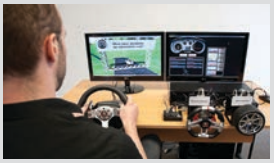
QUBE-Servo 2
Available with the QFLEX 2 USB and Embedded interfacing panel

Rotary Servo Base Unit
For a complete range of Rotary Servo-based experiments, see page 4

Linear Servo Base Unit
For a complete range of Linear Servo-based experiments, see page 3

ALSO SEE:
- Rotary Flexible Link, page 4
- Rotary Flexible Joint, page 4

Extending Use of Quanser Systems



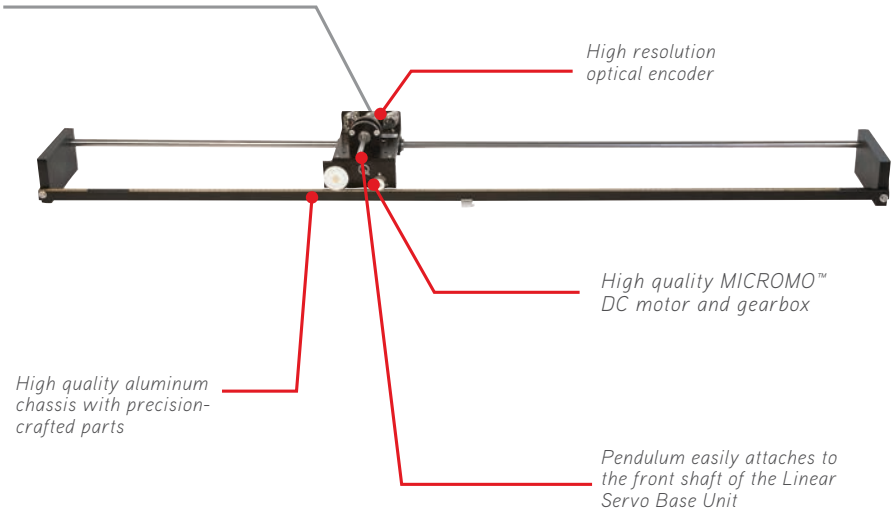
The Quanser Driving Simulator is a dynamic, real-time Hardware-in-the-Loop (HIL) simulation and high fidelity 3D representation of a car driving in a closed virtual environment. While resembling an exciting video game, it's actually a highly motivating, interactive controls teaching tool as proven by undergraduate students at the University of Toronto, Canada.

The servo motors – whether using QUBE-Servo or Rotary Servo Base units – are programmed to represent the speed and position control of a real car. Through software, the motors are connected to a model of the vehicle dynamics, a racetrack, and a driver model. In essence this is a true HIL automotive control system, and the control theory runs through all of these components. The actual relevance of very theoretical concepts becomes clear and intuitive.

LINEAR MOTION CONTROL SYSTEMS

The linear motion control platforms – whether based on the linear servo system or the HFLC high fidelity linear drive system, address the challenges of highly complex applications. The linear motion control laboratory configurations from Quanser enable students to explore a range of control strategies hands-on. At the same time, the deterministic dynamics of the systems and their modular and open-architecture design enable researchers to develop new strategies towards intelligent and nonlinear control schemes, system identification, time delayed systems and more.

LINEAR SERVO BASE UNIT



RECOMMENDED LINEAR SERVO BASE WORKSTATION COMPONENTS:

- Q2-USB data acquisition device

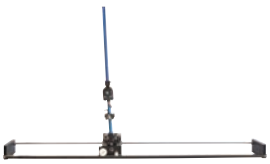
- VoltPAQ-X1 amplifier

QuaRC Quanser Real-time Control

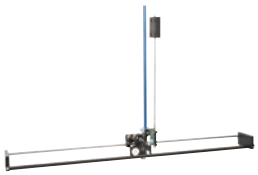
- QUARC control software for MATLAB/Simulink

+ ADD-ON MODULES FOR THE LINEAR SERVO BASE UNIT AND OTHER LINEAR MOTION CONTROL SYSTEMS

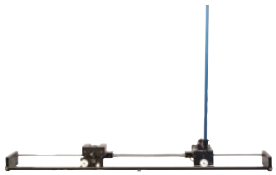
- **Linear Pendulum**
  Pendulum provided with the Linear Servo Base Unit



- **Linear Double Inverted Pendulum**



- **Linear Flexible Inverted Pendulum**



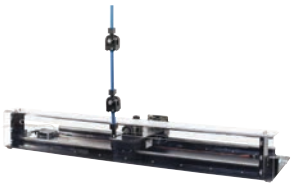
- **Linear Flexible Joint with Inverted Pendulum**

- **Linear Flexible Joint**

- **Seesaw**

- **Linear Flexible Joint on Seesaw**

- **Seesaw Pendulum**
  This experiment setup requires two Seesaw and two Linear Pendulum modules



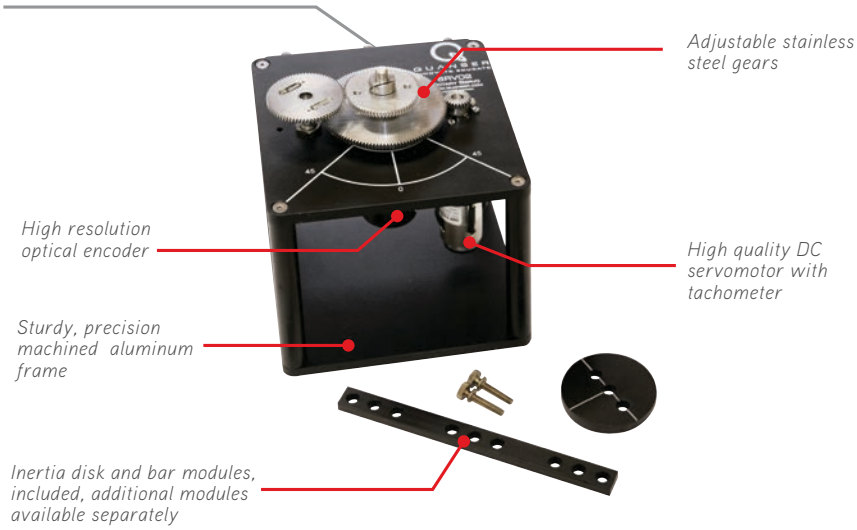
- **HFLC High Fidelity Linear Cart with Single, Dual, Double and Triple (pictured) Inverted Pendulums**

ROTARY MOTION CONTROL SYSTEMS

Rotary drive systems are used in many systems in all fields of industry. Innovations in this field involve novel strategies for the integration and control of multi-body systems with an increasing number of degrees of freedom. A key element in the solution to such challenges is resident in understanding of the dynamics, robustness and precision of the control strategy used.

The Rotary Servo Base Unit is the heart of the legendary Quanser Rotary Solution, and will offer your undergraduates the absolute best experience in their control course. Advanced features, research grade components, and a large selection of modular experiment add-ons constitute a truly flexible, open architecture platform that will continue to serve your students in their advanced courses and right into post-graduate research careers.

ROTARY SERVO BASE UNIT



RECOMMENDED ROTARY SERVO BASE WORKSTATION COMPONENTS:

- Q2-USB data acquisition device

- VoltPAQ-X1 amplifier

QuaRC Quanser Real-time Control

- QUARC control software for MATLAB/Simulink

+ ADD-ON MODULES FOR THE ROTARY SERVO BASE UNIT

- Ball and Beam

- Rotary Flexible Joint

- Rotary Flexible Link

- Rotary Inverted Pendulum

- Rotary Double Inverted Pendulum

- Gyro/Stable Platform

- 2 DOF Robot

- 2 DOF Inverted Pendulum

- Multi-DOF Torsion

- 2 DOF Ball Balancer

ALSO SEE:

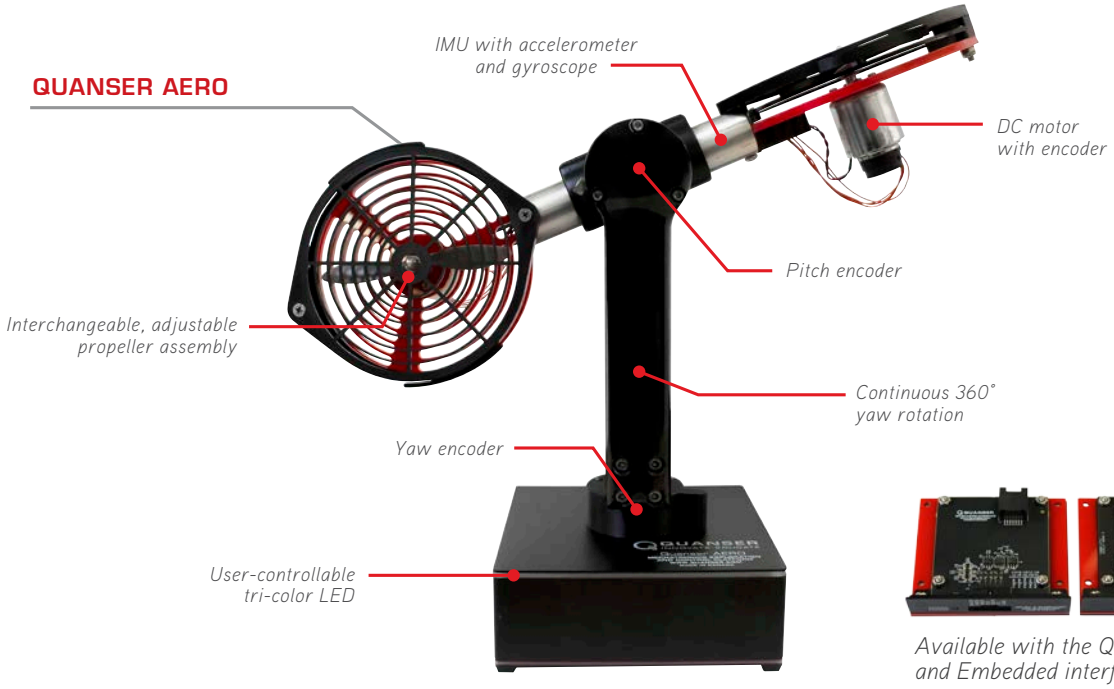
- QUBE-Servo 2, page 2

FLIGHT CONTROL SYSTEMS

Quanser's extensive line of control systems plants include experiments and test rigs designed specifically for teaching and research in flight dynamics and control. Most of these systems offer the fidelity and flexibility to move cleanly from an undergraduate course to the graduate level and ultimately to leading edge research.

Using Quanser systems, students can build their knowledge of position control, essential dynamics of flight control and gyroscopic motion. At the graduate level, they can expand this knowledge and explore more advanced control concepts, using the same hardware and software environment. The control challenges stemming from inherent nonlinearities, cross-couplings and uncertainties in the dynamics of the systems involve areas such as adaptive control, nonlinear control, robust control, and optimal control.

QUANSER AERO



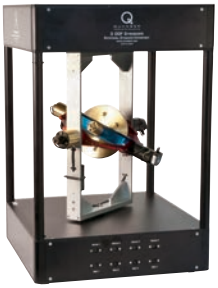
Available with the QFLEX 2 USB and Embedded interfacing panel

MORE PRODUCTS FOR STUDY OF FLIGHT DYNAMICS AND CONTROL

2 DOF Helicopter

3 DOF Helicopter

3 DOF Hover



3 DOF Gyroscope

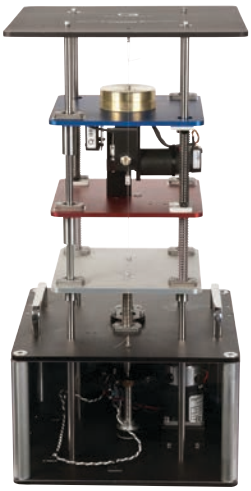
ALSO SEE:

- 2 DOF Inverted Pendulum, page 4
- Gyro/Stable Platform, page 4
- QBall 2, page 7

INDUSTRIAL APPLICATIONS AND PROCESS CONTROL

Today's industrial systems are complex, encompassing all engineering fields, from control systems and mechanisms, to electronics, software and computer architecture. Many of Quanser's experimental plants can emulate complex mechatronic systems. With their precision, robust and open architecture design, they present highly suitable and affordable options for study and research of control-related challenges encountered in industrial technologies and applications, including fluid level control, temperature control, car suspension control, and more.

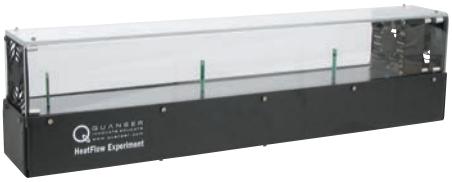
3 DOF Crane



Active Suspension

Coupled Tanks

Magnetic Levitation



Heatflow Experiment

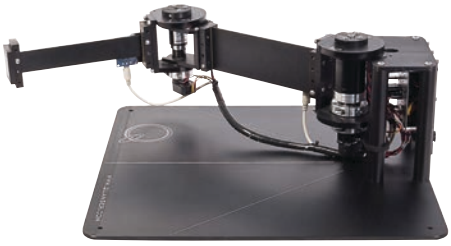
CONTROL OF ROBOTIC AND AUTONOMOUS SYSTEMS

Control of robotic systems is a core part of the Robotics and Intelligent Systems courses in Electrical and Computer Engineering, Mechanical Engineering and Mechatronics Engineering. Quanser plants offer the right mix of features, precision, robustness, and flexibility for a wide range of introductory to advanced courses in robotic systems control. The systems demonstrate fundamental concepts, including forward and inverse kinematics, manipulator dynamics, trajectory planning, vision systems and vision guided motion, control of multiple link manipulators and unmanned systems.

Quanser has established strategic partnerships with key industrial robotic companies that allow researchers to benefit from completely open architecture and extremely flexible robotic platforms. These platforms enable innovative research to be performed using market leading robotic systems without the limitations of the typical closed controllers.

6 DOF Denso Open Architecture Robot

2 DOF Serial Flexible Joint



2 DOF Serial Flexible Link

Robotics Package for Education

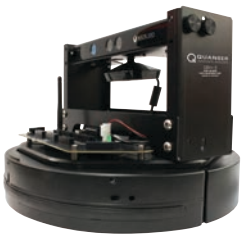
4 DOF serial manipulator with 10 software licenses

Robotics Platform for Research

6 DOF serial manipulator

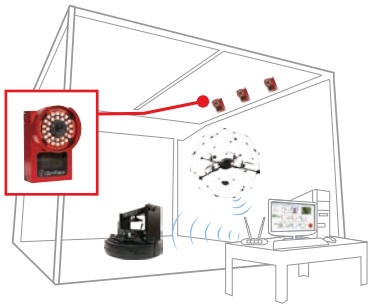
ALSO SEE:

- Rotary Flexible Joint, page 4
- Rotary Flexible Link, page 4
- 2 DOF Robot, page 4
- 2 DOF Inverted Pendulum, page 4
- Multi-DOF Torsion, page 4
- Omni Bundle, page 8



QBot 2

QBall 2



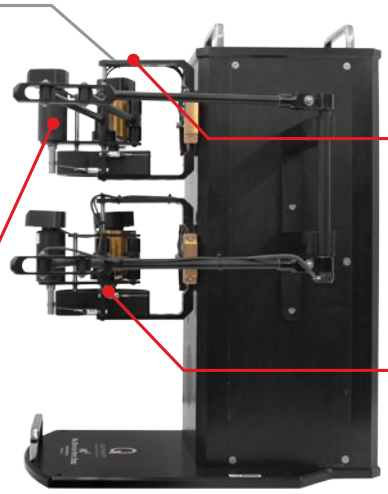
Unmanned Vehicle Systems Lab

Consists of QBall 2 and QBot 2 vehicle(s), multi-camera system and control station with software

HAPTIC SYSTEMS

Haptic technology is finding many applications in medical training, rehabilitation, areas requiring handling of dangerous materials, as well as in the entertainment and gaming industries. Research applications require platforms capable of reproducing movements and forces accurately, yet cost-effectively, through flexible frameworks on open-architecture devices. Quanser haptic devices - leveraging more than two decades of our expertise in control - offer researchers the ability to easily and quickly change parameters of control systems, swap or customize haptic devices to adapt them to the specific needs of your research team.

HD² HIGH DEFINITION HAPTIC DEVICE



RECOMMENDED HD² WORKSTATION COMPONENTS

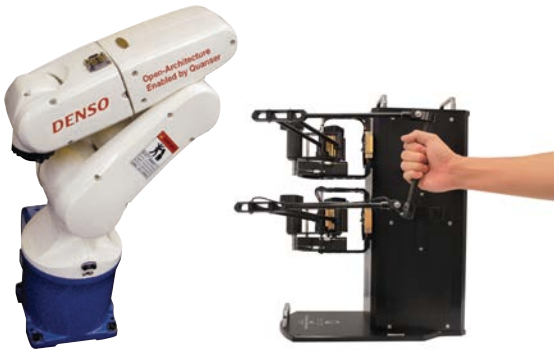
- QPIDe Data Acquisition Device

QuaRC Quanser Real-time Control

- QUARC control software for MATLAB/Simulink

MORE PRODUCTS FOR HAPTIC APPLICATIONS

- OMNI Bundle



- Telepresence System with 6 DOF Denso Open Architecture Robot

Quanser Expertise Helps in Development of MRI-compatible Surgical Robot

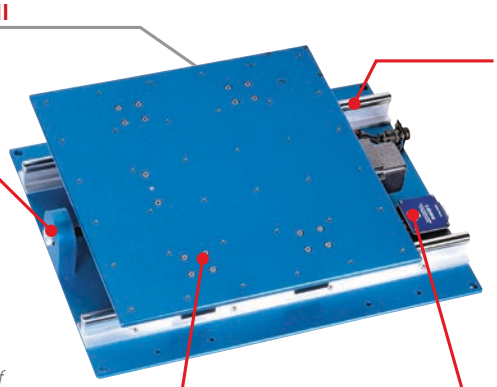
The Health Research Innovation Centre at the University of Calgary, Canada is using the Quanser augmented 7 DOF HD² High Definition Haptic Device and the 6 DOF Denso Open Architecture Robot equipped with a custom-designed end-effector tool for research and development of the neuroArm, a robotic arm used for telesurgery. The system is equipped with high-definition force torque sensing, with programming and control design through Quanser's QUARC real time control software.

STRUCTURAL DYNAMICS AND ANALYSIS

The structural dynamics and analysis topics are a part of the engineering undergraduate and graduate curriculum in Civil Engineering, Mechanical Engineering and Aerospace Engineering. Quanser systems offer a valuable hands-on extension of these highly theoretical courses, allowing study of the responses of structures and materials to vibrations caused by earthquakes or winds. Precise, robust, and flexible, Quanser shake table and smart structure platforms meet the needs of educators and researchers for reliable, low maintenance and cost-effective devices. With these systems you can demonstrate various control techniques used to manipulate and dampen structural vibrations and introduce more advanced multi-dynamic analysis.

Quanser shake tables and smart structures platforms are also ideally suited for research in engineering fields focusing on advanced vibration analysis and isolation, the study of response and elastic limits of structures and geo-materials subjected to dynamic loads.

SHAKE TABLE II



Single axis operation, dual-axis operation achievable using two Shake Table II units

Ball-screw mechanism for robust actuation

Easy integration of Quanser or user-built structures, third-party sensors and actuators

Precise and accurate positioning using high-resolution encoder

RECOMMENDED SHAKE TABLE II WORKSTATION COMPONENTS

- Q8 data acquisition device

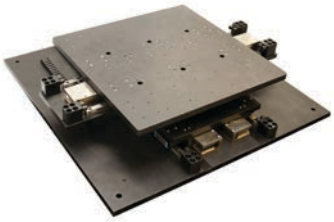
- AMPAQ-PWM

QuaRC
Quanser Real-time Control

- QUARC control software for MATLAB/Simulink

MORE PRODUCTS FOR STUDY OF STRUCTURAL DYNAMICS AND ANALYSIS

- Shake Table I-40



- XY Shake Table III

- Hexapod*

- Active Mass Damper
  Available as 1 Floor and 2 Floor models

- Smart Structure

**Hexapod is not available for purchase in North America, Japan and Taiwan. For details, please contact info@quanser.com*

Multi-point Shaking Experiments

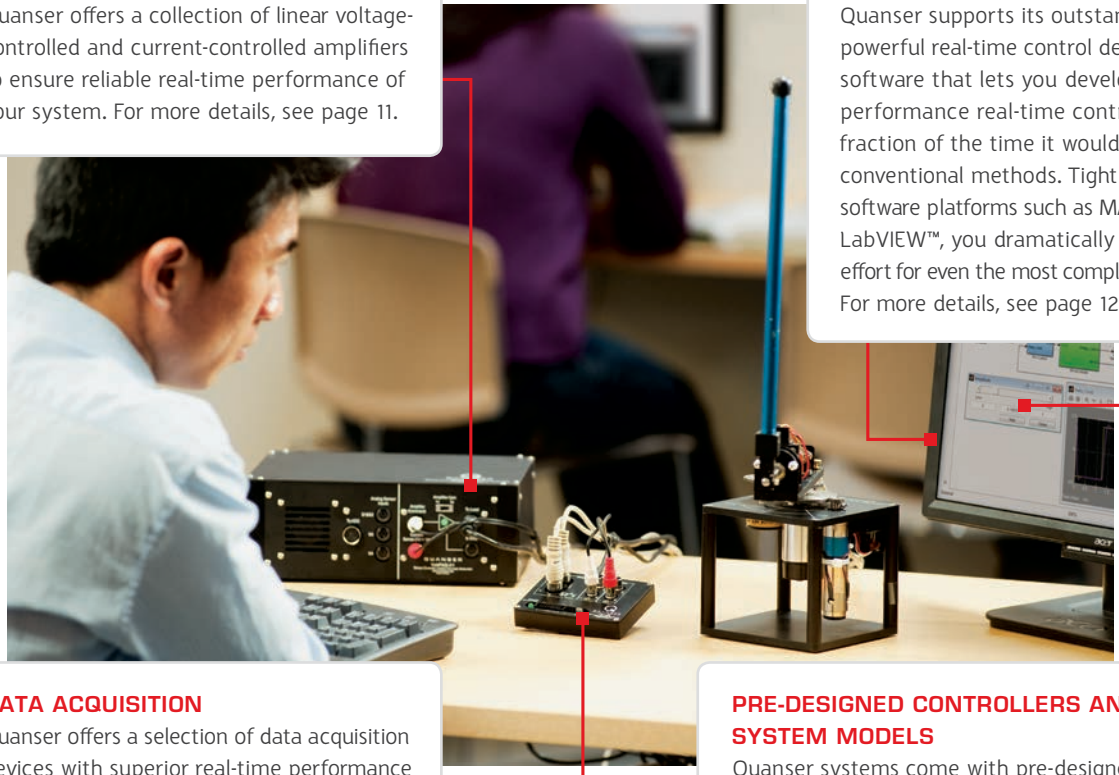
For his research, Professor Haibei Xiong from the Tongji University, China, is using four Shake Tables II with synchronized motion to for high load and multi-points shaking of a bridge structure. He also uses the Shake Tables for teaching complex concepts of structural dynamics and earthquake engineering.

A SINGLE SOURCE SOLUTION FOR YOUR LAB

Quanser turn key systems come complete with all components and peripherals you will need, including an amplifier, data acquisition device, control design software, pre-designed controllers, dynamic model and courseware materials. This gives you a versatile, robust and flexible workstation, optimized for maximum efficiency and your teaching and research courseware needs.

AMPLIFIERS

Quanser offers a collection of linear voltage-controlled and current-controlled amplifiers to ensure reliable real-time performance of your system. For more details, see page 11.



CONTROL DESIGN SOFTWARE

Quanser supports its outstanding hardware with powerful real-time control design and prototyping software that lets you develop complex, high-performance real-time control applications in a fraction of the time it would take with C or other conventional methods. Tightly linked to high-level software platforms such as MATLAB®/Simulink® and LabVIEW™, you dramatically reduce your coding effort for even the most complex control applications. For more details, see page 12.

DATA ACQUISITION

Quanser offers a selection of data acquisition devices with superior real-time performance and easy setup. Options include plug and play USB DAQs, high performance PCI Express boards, and specialized platform support such as NI CompactRIO, and NI myRIO. For more details, see page 11.

PRE-DESIGNED CONTROLLERS AND DYNAMIC SYSTEM MODELS

Quanser systems come with pre-designed controllers based on either QUARC® control design software for MATLAB®/Simulink® or RCP Toolkit for LabVIEW™. The controllers address a wide variety of control strategies, from the most basic to advanced control, providing you with a head start for your teaching and research. Quanser systems also come with fully documented system models.

COMPREHENSIVE COURSEWARE

Most Quanser teaching systems come with course material that covers a wide range of essential concepts from modeling and system characterization, to analysis, controller design, and real-time implementation. Instructors can easily integrate Quanser systems into existing labs or start new lab-based courses without having to spend months on courseware development. For more details, see page 13.

PERIPHERALS

Quanser turn key solutions for engineering labs come complete with all peripherals, including data acquisition devices and amplifiers. The peripherals interface with the physical plant and control software and can be used with a variety of Quanser mechatronic experiments or in customized setups.

VOLTAGE-CONTROLLED POWER AMPLIFIERS

- VoltPAQ-X1

- VoltPAQ-X2

- VoltPAQ-X4

CURRENT-CONTROLLED POWER AMPLIFIERS

- AMPAQ-L2

- AMPAQ-L4

- AMPAQ-PWM

DATA ACQUISITION DEVICES

- Q2-USB

- Q8-USB

- QPIDe with Terminal Board

- Q1-cRIO module for NI CompactRIO

- Quanser Terminal Board for NI myRIO

CONTROL SOFTWARE
DESIGNED BY CONTROL ENGINEERS FOR CONTROL ENGINEERS

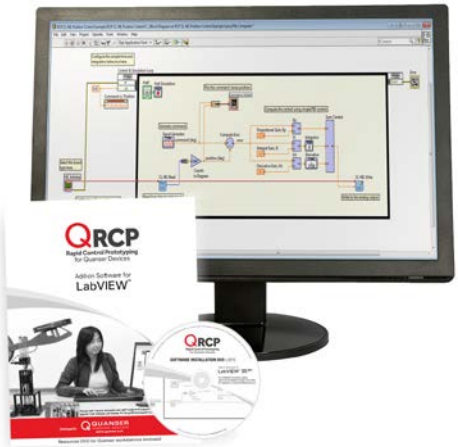
Quanser control software is an integral part of all Quanser solutions. QUARC® for MATLAB®/Simulink® and Rapid Control Prototyping (RCP) Toolkit for LabVIEW™ are two powerful rapid control prototyping tools that significantly accelerate control design and implementation. Originally designed for industrial demands, with these software tools Quanser pioneered the realization of high-performance real-time control on common computers and enabled new applications in control, mechatronics and robotics.

QUARC FOR MATLAB/SIMULINK USERS

The Quanser QUARC® real-time software seamlessly integrates with MATLAB® and Simulink®, and extends their capabilities, allowing for rapid controls prototyping and hardware-in-the-loop testing. Also fully integrated with Simulink Coder™, QUARC allows you to draw a controller, generate code and run it in real-time without time-consuming hand coding. QUARC also offers a suite of blocks that help researchers seamlessly interface and control third-party devices such as KUKA and Denso robots, Schunk grippers or PGR cameras, to name just a few. With enhanced modeling and visualization, flexible and protocol-independent communication framework and multiple operating system support, complex applications become feasible, and easier to manage.
In spite of its power, working with QUARC is easy enough for undergraduate students, allowing them to focus on important control aspects. Students can tune parameters of the running model by changing block parameters in the Simulink diagram and view the status of a signal in the model while the model runs on the target. Furthermore, data can be streamed for off-line analysis.

RAPID CONTROL PROTOTYPING TOOLKIT FOR LABVIEW USERS

The Quanser Rapid Control Prototyping Toolkit is an add-on for the LabVIEW™ graphical development environment. It significantly simplifies hardware setup and interfacing by taking care of all of the standard low level software and hardware configurations. The resulting control VIs are clear and closely match the standard block diagram system representation of control courses. This helps bridge the theory and practical implementation, and enables students to focus more on the control topics you are teaching. With expanded compatibility and support for NI myRIO portable embedded hardware device, CompactRIO programmable automation controller and PXI, an open PC-based platform, you can teach and perform an advanced control research using LabVIEW environment.



COMPLETE COURSEWARE RESOURCES

Quanser courseware covers the key topics that you want to teach in your control course. Starting with modeling and system characterization, it follows with a wide range of engaging, hands-on exercises for control analysis and controller design. Depending on the control plant, many courseware collections extend well beyond the undergraduate level and into graduate level advanced control. Some products even feature innovative applications that map traditional control concepts to exciting real-world applications.

OPEN, CUSTOMIZABLE COURSEWARE

Our latest focus in courseware development emphasizes flexibility and open access. For example, the new QUBE-Servo provides a unique, modular, mix and match approach to courseware. Additionally, the courseware documents are provided in several open, editable digital formats to including Word and LaTeX, minimizing the time to adapt the material to your particular course.

ABET-ALIGNED COURSEWARE

Our courseware is developed in partnership with leading experts and universities around the world and many of the collections are aligned with ABET accreditation criteria to ensure quality and relevance to current approaches to engineering education.

New Courseware for a Control Lab Staple

With the ever increasing popularity of embedded microcontrollers, students are more and more likely to be exposed to issues inherent to digital controller implementations in their future roles as engineers. To de-mystify the control challenges that arise from digital control, Quanser engineers are developing a new series of lab exercises. The Digital Control lab sequence allows students to investigate the effects of different sampling rates on the performance of a continuous PD position controllers, and how digital controllers can be approximated. Students also learn how to design digital controllers directly, improving their understanding of the discrete control design process. Typical hardware implementation issues such as quantized measurement signals and buffer overruns are also addressed.

The courseware has been tested by students taking the Modeling and Computer Control of Mechatronic Systems course at Queen's University, Canada. Their feedback confirmed that the course helped them better understand the theory discussed in lectures, and will be directly applicable to future design and research projects.

QUANSER PRODUCTS AND SOLUTIONS

APPLICATION	PRODUCTS
Introduction to Control Systems page 2	QUBE-Servo 2 Rotary Servo Base Unit Linear Servo Base Unit
Linear Motion Control system page 3	Linear Servo Base Unit Double Inverted Pendulum Linear Flexible Joint with Inverted Pendulum Seesaw Seesaw Pendulum Linear Inverted Pendulum Linear Flexible Inverted Pendulum Linear Flexible Joint Linear Flexible Joint on Seesaw HFLC High Fidelity Linear Cart
Rotary Motion Control System page 4	Rotary Servo Base Unit Rotary Flexible Joint Rotary Flexible Link Gyro/Stable Platform 2 DOF Robot Multi-DOF Torsion Ball and Beam Rotary Inverted Pendulum Rotary Double Inverted Pendulum 2 DOF Inverted Pendulum 2 DOF Ball Balancer
Flight Control System Design page 5	Quanser AERO 2 DOF Helicopter 3 DOF Helicopter 3 DOF Hover 3 DOF Gyroscope
Industrial Applications and Process Control page 6	3 DOF Crane Active Suspension Magnetic Levitation Coupled Tanks Heatflow Experiment
Control of Robotic and Autonomous Systems page 7	2 DOF Serial Flexible Joint 2 DOF Serial Flexible Link Quanser Robotic Package for Education Quanser Robotic Platform for Research 6 DOF Denso Open Architecture Robot QBall 2 QBot 2
Haptics Systems page 8	HD² High Definition Haptic Device OMNI Bundle Telepresence System with 6 DOF Denso Open Architecture Robot
Structural Dynamics and Analysis page 9	Shake Table I-40 Shake Table II XY Shake Table III Hexapod Active Mass Damper *Available as 1 and 2 Floor models* Smart Structure

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we help to find

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