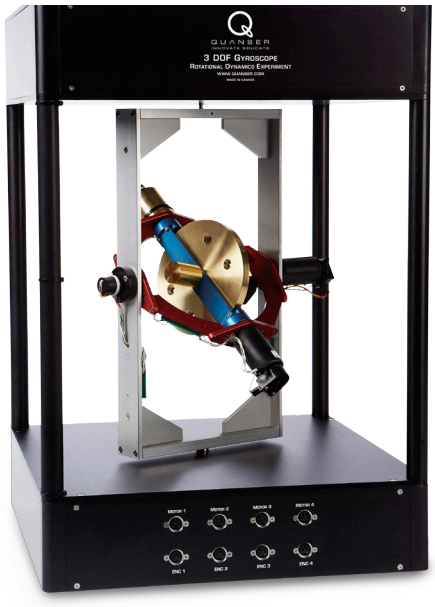
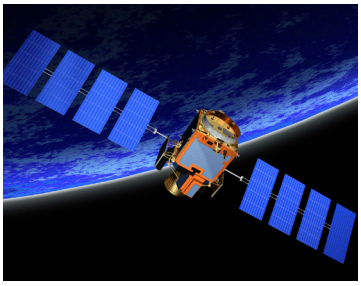
3 DOF GYROSCOPE

The 3 DOF Gyroscope is a diverse experimental platform that can be used to teach rotational dynamic challenges. With applications in flight control and satellites, this experiment is guaranteed to engage your students.



System specifications on reverse page.

GIVE STUDENTS CONTROL OF A REAL-WORLD APPLICATION



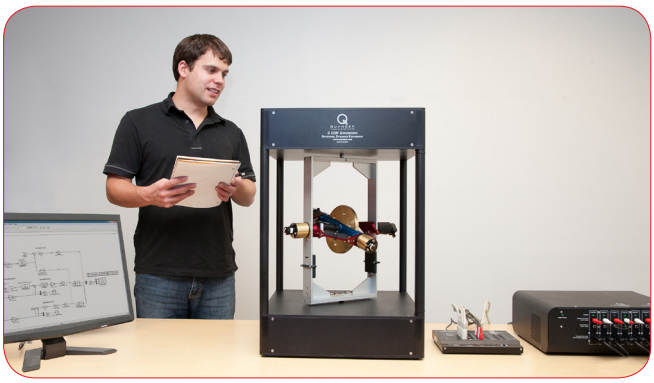
The principles demonstrated by the Quanser 3 DOF Gyroscope are relevant in technologies used to control orientation in sea, air and space vehicles. Extensive applications of the 3 DOF Gyroscope include altitude control, momentum wheel control, navigation, satellite orientation and auto-pilot systems. Furthermore, gyroscopic sensors are now found in a wide range of technical devices such as smart phones, tablets, video game controllers, and so on. Your students can cultivate a deep understanding of control theories through real-life applications.

HOW IT WORKS

The 3 DOF Gyroscope utilizes the principles of angular momentum to measure and sustain orientation. This robust system consists of a disk mounted inside an inner blue gimbal which in turn is mounted inside an outer red gimbal. The entire structure is supported by a rectangular silver frame that is free to rotate about its vertical axis of symmetry using a slip ring design. The gimbals are also equipped with slip rings, allowing them to rotate freely and giving the disk three degrees of freedom. The plant is equipped with four DC motors and four encoders. Separate motors actuate both the disk's spin axis and the blue and red gimbals. The fourth motor controls the gray rectangular frame which can be used to create a controlled disturbance. Digital position of all the axes is measured using high-resolution optical encoders. Although the gimbals and outer frame are free to rotate, the plant provides the ability to fix any desired axis (outer frame, red and blue gimbals). These different configurations allow for a wide range of experiments to be performed with the 3 DOF Gyroscope – a distinguishing feature, making this plant a valuable addition to a lab.

3 DOF GYROSCOPE WORKSTATION COMPONENTS

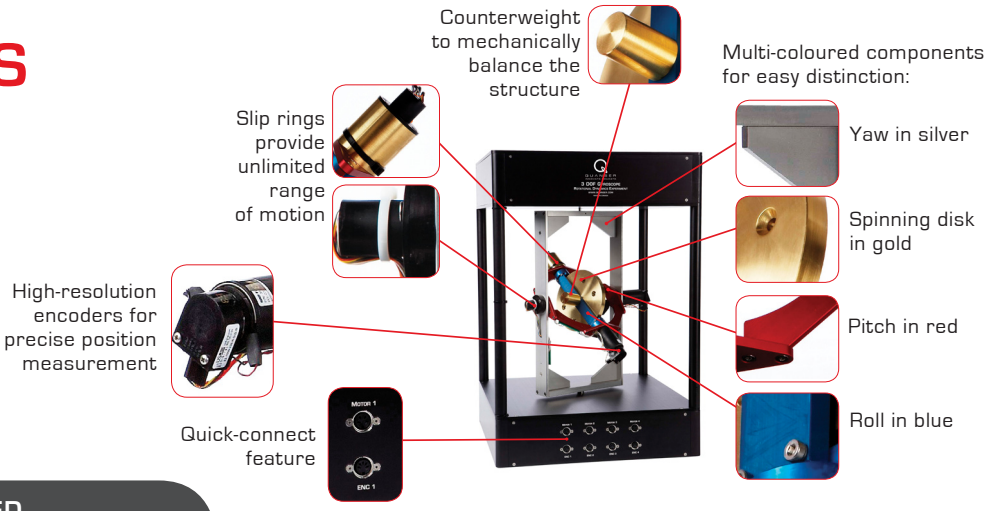
3 DOF Gyroscope plant
Q8-USB data acquisition device
AMPAQ-L4 linear current amplifier
QUARC real-time control software for MATLAB®/Simulink®
Laboratory Guide, User Manual, and Quick Start Guide (provided in digital format)
Sample pre-built controllers and complete dynamic model



3 DOF Gyroscope workstation

SYSTEM SPECIFICATIONS

3 DOF Gyroscope



CURRICULUM TOPICS PROVIDED

- System open-loop and closed-loop transfer functions
- Stability analysis using Routh-Hurwitz method
- Time-domain and frequency-domain control design and analysis
- Interactive simulations using virtual reality and on the fly parameter tuning
- Compensator design and tuning using Root Locus
- LEAD compensator design for gyroscope precession angle with on-the-fly real-time control parameter tuning
- Full state feedback LQR controller design with on-the-fly real-time control parameter tuning
- Non-minimum phase control design

FEATURES

- Flexible operation and control design from MATLAB®/Simulink® and LabVIEW™ via RCP Toolkit software using the Quanser Rapid Control Prototyping (RCP) Toolkit
- 4 DOF sensed and 4 DOF actuated (over-actuated system)
- Multi-coloured axes for distinction (yaw in silver, roll in blue and pitch in red)
- Mechanically balanced through the entire workspace
- High-resolution optical encoders for accurate measurement
- Precise, stiff and heavy-duty machined components
- Slip rings provide infinite continuous motion in each DOF
- Direct drive actuation to achieve negligible friction on all axes
- Fully documented system models and parameters
- Open architecture

DEVICE SPECIFICATIONS

Dimensions – H × W × L	70 cm × 50 cm × 50 cm
Device mass	27.3 kg
Disc encoder resolution (in quadrature)	4096 count/rev
Gimbal/frame encoder resolution (in quadrature)	4000 count/rev
Disk motor power	44.5 W
Gimbals/frame motor power	266 W
Rotor mass	1.91 kg
Rotor diameter	0.152 m
Rotor thickness	0.0127 m

COMPLETE WORKSTATION COMPONENTS

Plant	3 DOF Gyroscope
Control design environment	Quanser QUARC® add-on for MATLAB®/Simulink® Quanser Rapid Control Prototyping (RCP) Toolkit add-on for NI LabVIEW™
Documentation	Quick Start Guide, User Manual and Laboratory Guide
Real-time targets	Microsoft Windows® and NI CompactRIO
Data acquisition devices	Quanser QPID/QPIDe, Q8-USB, or NI CompactRIO with four Quanser Q1-cRIO modules
Amplifier	Quanser AMPAQ-L4 multi-channel linear current amplifier

The linear state space model and a sample controller(s) are supplied

About Quanser:

Quanser is the world leader in education and research for real-time control design and implementation. We specialize in outfitting engineering control laboratories to help universities captivate the brightest minds, motivate them to success and produce graduates with industry-relevant skills. Universities worldwide implement Quanser's open architecture control solutions, industry-relevant curriculum and cutting-edge work stations to teach Introductory, Intermediate or Advanced controls to students in Electrical, Mechanical, Mechatronics, Robotics, Aerospace, Civil, and various other engineering disciplines.

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