QUANSER AERO

Dual-rotor aerospace experiment with reconfigurable dynamic components for mechatronics exploration and controls.

See system specifications on reverse.

FLEXIBLE PLATFORM FOR MECHATRONICS AND CONTROLS

The Quanser AERO is a fully integrated lab experiment, designed for teaching mechatronics and control concepts at the undergraduate level, as well as for advanced aerospace research applications.

The experiment is reconfigurable for various aerospace systems, from 1 DOF attitude control and 2 DOF helicopter to half-quadrotor. Integrating Quanser-developed QFLEX 2 computing interface technology, the Quanser AERO also offers flexibility in lab configurations, using a PC, or microcontrollers, such as NI myRIO, Arduino and Raspberry Pi. With the comprehensive course materials included, you can build a state-of-the-art teaching lab for your mechatronics or control courses, engage students in various design and capstone projects, and validate your research concepts on a high-quality, robust, and precise platform.

HOW IT WORKS

The Quanser AERO consists of two propellers, powered by DC motors. Combined with the light-weight design of the experiment, this makes the system capable of highly responsive movements. The Quanser AERO's compact base includes a built-in amplifier with an integrated current sensor, built-in data acquisition device, and an interchangeable QFLEX 2 interface panel. The experiment comes with additional propellers to illustrate the efficiency of different propeller designs and effects of cross-coupling.

The propeller motors are equipped with optical encoders. The motor current and voltage sensors can be used to monitor the power consumption of the experiment.

The slip ring mechanism allows for continuous 360° yaw rotation. The angles of the pitch and yaw axes are measured using high-resolution optical encoders. The pitch and yaw axis can be independently locked, and the angle of the propeller assemblies can be adjusted between horizontal and vertical positions. This allows users to reconfigure the Quanser AERO for various aerospace systems (1 DOF attitude control, 2 DOF helicopter, half-quadrotor) and experiments (e.g. pitch-only system modeling).

The Inertial Measurement Unit (IMU) board includes accelerometer and gyroscope sensors, which can be used for attitude and yaw estimation and verification against the direct position measurements from the encoders.

The Quanser AERO also has a user-controllable tri-color LED strip. It can be programmed to indicate state, power, or other control performance characteristics of the Quanser AERO.

QUANSER AERO SOLUTION COMPONENTS

- Quanser AERO with QFLEX 2 interface panel of your choice *(USB or Embedded)*
  Optional: Additional QFLEX 2 interface panel
- Quanser Control Software (required for Quanser AERO USB experiment): QUARC for MATLAB/Simulink or QRCP for LabVIEW*
- Complete dynamic model and pre-build controllers
- ABET[1]-aligned, flexible digital media courseware (for Quanser AERO USB experiment)
- Arduino examples and interfacing datasheet (for Quanser AERO Embedded experiment)

**MATLAB/Simulink and LabVIEW licenses not included*

QUANSER AERO INTERFACE OPTIONS

The Quanser AERO is available with two different, easily interchangeable interface panels:

- Quanser AERO USB experiment (with QFLEX 2 USB panel) interfaces to Quanser's control software running on your lab's PC via a standard USB 2.0 connection. The Quanser AERO USB can be used with MATLAB®/Simulink® and Quanser QUARC software, or with LabVIEW™ using the Quanser RCP software. With the USB version of the experiment, you can take full advantage of the comprehensive course materials and lab experiments for your controls-based courses and projects.
- Quanser AERO Embedded experiment (with QFLEX 2 Embedded panel) interfaces to your microcontroller (not included with the experiment) via SPI connection. The Quanser AERO Embedded does not require any additional software. This option is ideal to expose students to various microcontroller techniques, as well as for final (capstone) projects in mechatronics, control, or other similar programs.

Note: The Quanser AERO experiment includes one interface panel of your choice. Additional interface panel(s) can be purchased separately.

[1] ABET, Inc. is the recognized accreditor for college and university programs in applied science, computing, engineering, and technology.

SYSTEM SPECIFICATIONS

Quanser AERO

FEATURES

- Compact and integrated system
- High-efficiency coreless DC motors
- High resolution optical encoders
- Pitch & yaw axes and DC motors/rotors speed measurements through digital tachometer
- Built-in voltage amplifier with integrated current sensor
- Integrated data acquisition(DAQ) device
- User-controllable tri-color LED
- Easy-connect cables and connectors
- Flexible QFLEX 2 computing interface for USB and SPI connections
- Open architecture design, allowing users to design their own controller
- Fully compatible with MATLAB®/Simulink® and LabVIEW™
- Fully documented system models and parameters provided for MATLAB®/Simulink® and LabVIEW™
- ABET-aligned, modular, digital media courseware provided for the Quanser AERO USB
- Microcontroller examples and interfacing datasheet provided for the Quanser AERO Embedded
- Additional community-created resources available on www.QuanserShare.com

COURSEWARE TOPICS COVERED

The Quanser AERO USB courseware includes
ABET[1]-aligned **Instructor and Student Workbooks** with complete lab exercises, covering topics:

- Hardware integration
- Single propeller speed control

1 DOF attitude control configuration:

- PID control
- Introduction to IMU
- Modeling using transfer function
- System identification
- Gain scheduling

Laboratory Guides with modeling and control design examples:

2 DOF helicopter configuration

- Modeling
- Linear state-space representation
- State-feedback control
- Coupled dynamics

Half-quadrotor configuration

- Modeling
- Simple yaw control
- Kalman filter

DEVICE SPECIFICATION

Base dimensions (W x H x D)	17.8 cm x 17.8 cm x 7 cm
Device height (with propeller in horizontal position)	35.6 cm
Device length	51 cm
Device mass	3.6 kg
Propeller diameter	12.7 cm
Yaw angle range	360°
Elevation angle range	124° (± 62° from horizontal) half-quadrotor configuration
Pitch encoder resolution (in quadrature)	512 counts/revolution
Yaw/travel encoder resolution (in quadrature)	1024 counts/revolution
Motor current torque constant	57.7 mN.m/A
Tri-axis gyroscope range	± 245 dps
Tri-axis accelerometer range	± 2g
Interfaces available: QFLEX 2 USB	USB 2.0
QFLEX 2 Embedded	SPI

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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