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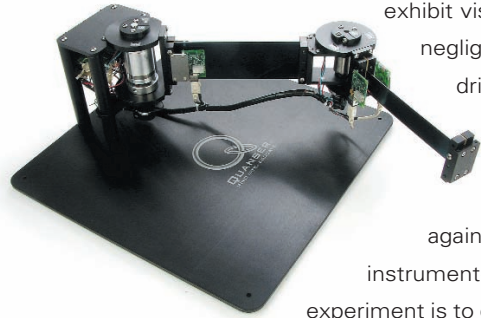
SPECIALTY CONTROL CHALLENGE



2DOF Serial Flexible Link Experiment

Product Information Sheet S27 - 1

Description



The 2DOF Serial Flexible Link is a simplified model of a robotic arm in which the links are designed as to exhibit visible harmonics during accelerations, while flexure in the joints is negligible. This experimental system consists of two DC motors each driving harmonic gearboxes (zero backlash), and two serial linkages. The primary link attached to the first motor is flexible and is instrumented with a strain gage sensor. It carries at its end the second motor to which the second flexible link is attached, again instrumented with a strain gage sensor. Both motors are further instrumented with high-resolution optical encoders. The purpose of the experiment is to design a control system to position the robot tip in a plane (2-DOF) as rapidly as possible with minimum vibrations. The end-effector planar position to track and/or regulate is of the two-bar serial-kinematic mechanism that has two flexible links. The Multi-Input Multi-Output (MIMO) system is supplied with a decoupled state-feedback controller reducing flexibility-caused oscillations as well as link-coupling effects. However, this system is fully open-architecture and you may design any other controller you wish. A manual accompanies this experiment describing the development of the control law used, as well as providing useful setup information and specifications.

Key Features

- fully compatible with LabVIEW and MATLAB/Simulink
- high quality aluminum chassis with precision crafted components
- high-resolution encoders and strain gages to sense link deflection
- fully documented system models & parameters
- complete manual describing the development of the control laws used, as well as providing useful setup information and specifications
- open architecture design for maximum flexibility

Practical Controller Investigations

- Disturbance Rejection
- Tracking Control & Regulation
- Full-State Feedback
- Observer Design & Implementation
- Frequency Analysis
- Lead / Lag Compensation
- Vibration & Resonance
- System Modeling & Simulation
- Root Locus Design
- Nyquist Stability
- Robotics
- Real-Time Control
- Discrete Time Sampling
- System Identification
- Multivariable Control Design

Range of Quanser
Specialty
Experiments

Quanser has developed an extensive range of complex Specialty Challenges, a select sample of these experiments includes:

Specialty Control Challenges

| | |
|------------------------------------|---|
| 2 DOF Helicopter | 2 DOF Serial Flexible Link / Joint |
| 3 DOF Helicopter | Industrial Mechatronic Drives Unit |
| 3 DOF Hover | High Fidelity Linear Cart System |
| MAGLEV (Magnetic Levitation) | Triple Inverted Pendulum, Dual Inverted Pendulum |
| Coupled Tanks | 5 DOF Open Architecture Robots |
| Heatflow Experiment | Mechatronics Kit |
| Shaker Tables and Smart Structures | The Cube |

For details of these experiments and more, visit our website www.quanser.com



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Typical Response

SPECIALTY CONTROL CHALLENGE



2DOF Serial Flexible Link Experiment

Product Information Sheet S27 - 2

These graphs depict the measured response of the system to a square-wave input, using a state-feedback control scheme tuned with the Linear-Quadratic Regulator (LQR) algorithm without taking coupling into effect. The first graph on the left plots the actual measured angle of the first link (blue) vs. commanded (green trace) vs. on/off controller switching cycle (red trace). The graph on the right depicts link deflection only as a response to the same inputs. Link coupling may be observed.

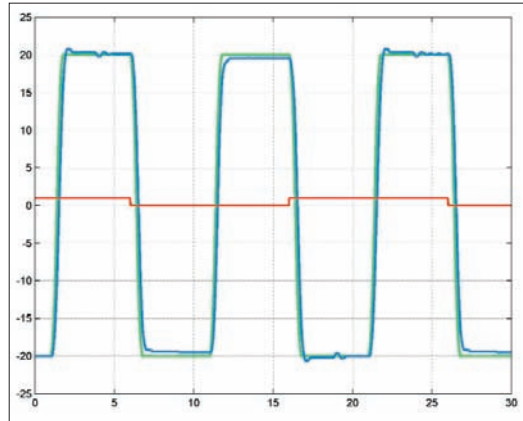


Figure 1 – Drive #1 Load Shaft Angular Response: θ_{11}

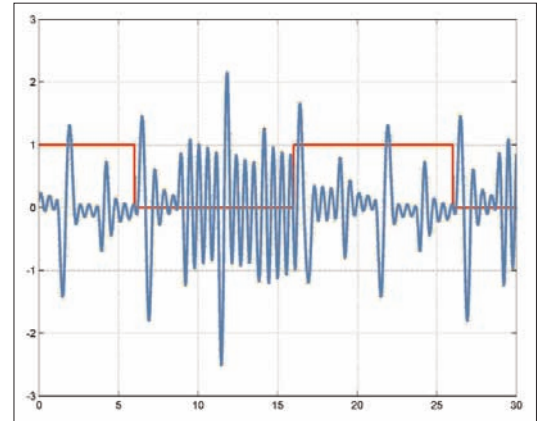


Figure 2 - Flexible Link #1 Angular Response: θ_{12}

System Requirements

The 2DSFL system requires the following components to complete the experimental setup:

| Component | Quanser Recommended (Common Configuration) | Alternative |
|------------------|--|--|
| Power Module | Quanser AMPAQ (included) | nil |
| Control Hardware | Quanser Q4, Q8 Series | dSPACE DS1104* National Instruments E- or M- Series DAQs* |
| Control Software | Quanser WinCon | The Mathworks – xPC dSPACE – ControlDesk National Instruments – Labview RT |

* Quanser offers interface boards for NI E-series & dSPACE DS1104 boards.

System Specifications

| Specification | Value | Units |
|---|--------------------|-----------|
| Dimensions (w x d x h) | 50.8 x 50.8 x 22.5 | cm |
| Max. displacement – Axis 1 | +/- 90 | degrees |
| Max. displacement – Axis 2 | +/- 90 | degrees |
| Encoder sensitivity (Quadrature) - Axis 1 | 1.534E-5 | rad/count |
| Encoder sensitivity (Quadrature) - Axis 2 | 1.918E-5 | rad/count |
| Max. Continuous Torque – Axis 1 | 8.6 | N.m |
| Max. Continuous Torque – Axis 2 | 1.7 | N.m |
| Max. additional payload | 0.5 | kg |

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