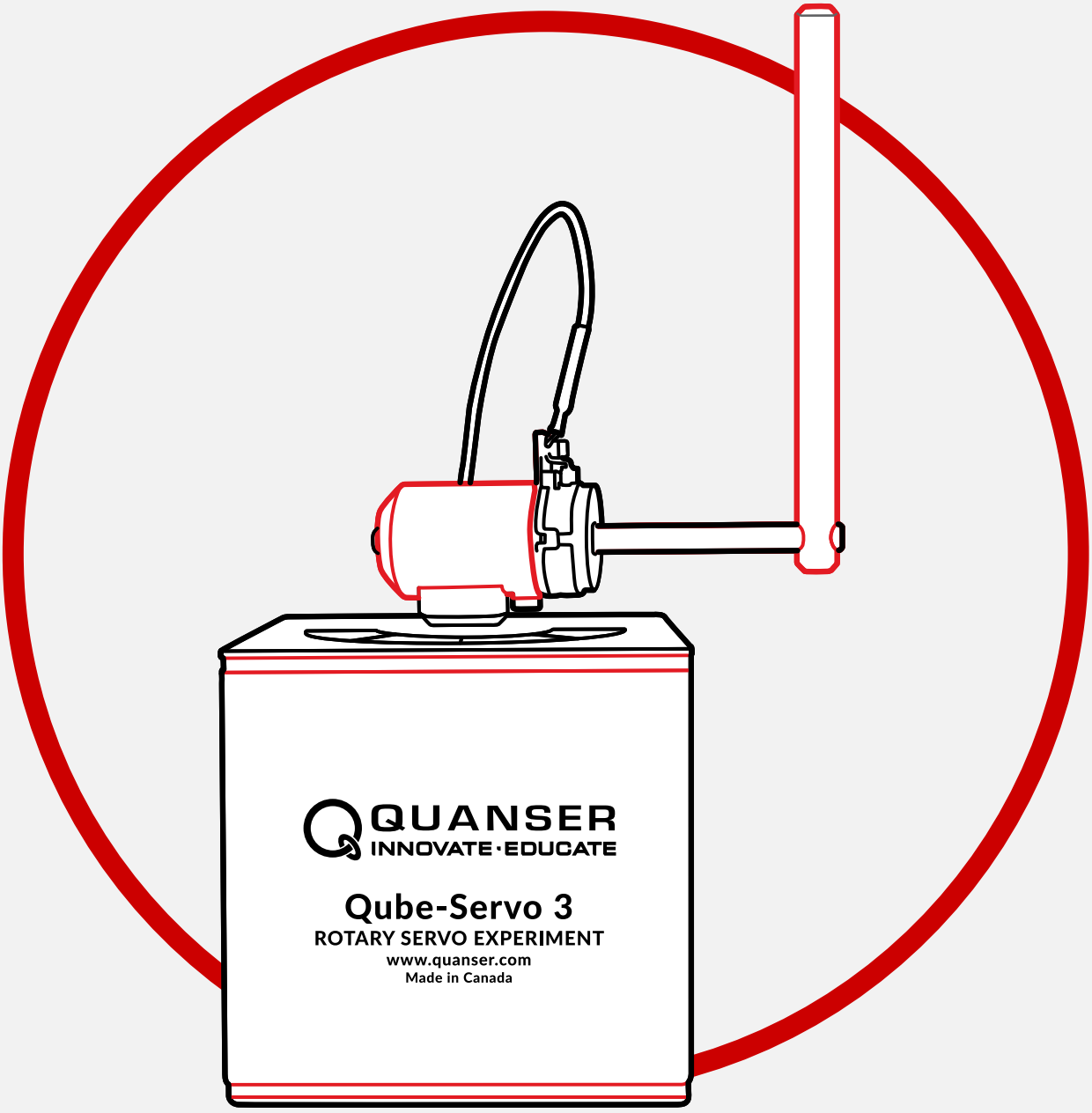
QUANSER
INNOVATE·EDUCATE



Qube-Servo 3

Steady State Error

V1.2 – 27th February 2025

For more information on the solutions Quanser offers,
please visit the web site at: http://www.quanser.com

Quanser Consulting Inc.
119 Spy Court
Markham, Ontario
L3R 5H6, Canada

info@quanser.com
Phone : 19059403575
Fax : 19059403576
printed in Markham, Ontario.

Caution

This equipment is designed to be used for educational and research purposes and is not intended for use by the public. The user is responsible for ensuring that the equipment will be used by technically qualified personnel only. Users are responsible for certifying any modifications or additions they make to the default configuration.

FCC Notice This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

Industry Canada Notice This Class A digital apparatus complies with CAN ICES-3 (A). Cet appareil numérique de la classe A est conforme à la norme NMB-3 (A) du Canada.
Japan VCCI Notice This is a Class A product based on the standard of the Voluntary Control Council for Interference (VCCI). If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI-A

Waste Electrical and Electronic Equipment (WEEE)
This symbol indicates that waste products must be disposed of separately from municipal household waste, according to Directive 2012/19/EU of the European Parliament and the Council on waste electrical and electronic equipment (WEEE). All products at the end of their life cycle must be sent to a WEEE collection and recycling center. Proper WEEE disposal reduces the environmental impact and the risk to human health due to potentially hazardous substances used in such equipment. Your cooperation in proper WEEE disposal will contribute to the effective usage of natural resources.

电子信息产品污染控制管理办法 (中国 RoHS)

中国客户Quanser Consulting Inc. 关于关于限制在电子电气设备中使用某些有害成分的指令 (RoHS)。

CE Compliance

This product meets the essential requirements of applicable European Directives as follows:
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)

Warning: This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

Qube-Servo 3 – Application Guide

Steady State Error

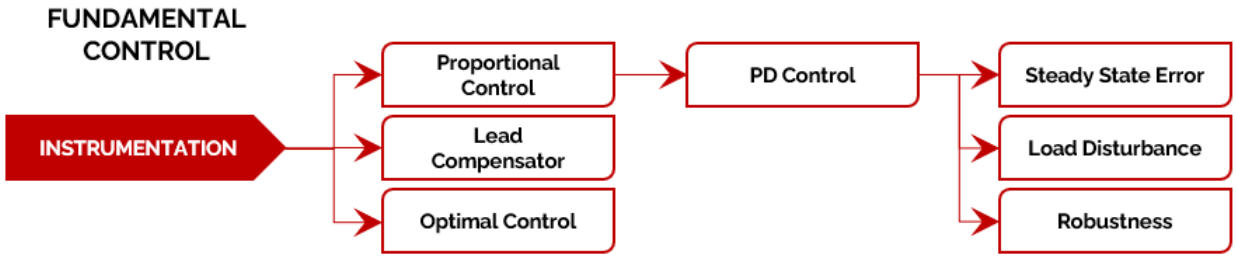
Why explore the Steady State Error?

Steady-state error—the difference between a system's desired and actual output—is a crucial metric in control system design. This error varies based on both the type of system and the control input being used. By analyzing the closed-loop system equations, we can predict the steady-state error before physical implementation. This theoretical analysis serves two vital purposes: it validates whether the control scheme is sufficient for the application's requirements, and it provides valuable insights into how different control strategies will influence the system's behavior.

Background

This lab is part of the Fundamental Control skills progression of the Qube-Servo 3. It will give you hands-on experience in applying fundamental control techniques to a physical system. It will help you understand how different control strategies can be used to regulate the motor's speed and position, the impact of load disturbances, and system robustness.

The lab progression is as follows:



Prior to starting this lab, please review the following concept reviews (should be located in Documents/Quanser/4_concept_reviews/):

- Concept Review – Controls → PID Control (For Qube-Servo/PID Position Control Section)
- Concept Review – Controls → Steady State Error

Getting started

In this lab, you will use the transfer functions that describe the dynamics of the DC motor modelled from voltage input to position together with a PID controller, to analyze the system's response to different reference signals. You will calculate/analyse the steady state error then PID control will be implemented on hardware to validate your analysis.

Ensure you have completed the following labs:

- **SP0_ Instrumentation Labs**
- **Proportional Control**
- **PD Control Lab**

Before you begin this lab, ensure that the following criteria are met:

- If using a physical Qube-Servo 3, make sure it has been setup and tested. See the Qube-Servo 3 Quick Start Guide for details on this step. Make sure the inertia disc load is attached to the Qube-Servo 3.
- If using the virtual Qube-Servo 3, make sure you have Quanser Interactive Labs open in the Qube 3 - DC Motor → Servo Workspace.

- You are familiar with the basics of Simulink. See the Simulink Onramp for more help with getting started with Simulink.