Aircraft Response to Control Input
Data Collection System

Presenter: Curtis Cutright
Advisor: Dr. Michael Braasch

Project Sponsor: JUP
Presentation Overview

• Motivation

• Data Collection System Block Diagram

• System Component Description

• Unresolved Issues
Purpose

• Collect data on the response of the aircraft to the pilot’s control stick inputs
  » Control stick position, rudder position, body accelerations, body angular rates, altitude, body position, ground speed, airspeed, etc.

• This data can be used to create a model of the aircraft that can be used in simulations
Flight Test Vehicle

- L - 29 Delfin
- High Altitude
- High Speed
- Fully Aerobatic
Block Diagram Description

• Identify the purpose of the each block

• Discuss options to satisfy the requirements of each block
Position Sensors

- Continuously monitor the position of the control stick and throttle position
- Monitor the full range of control surface movement
- Critical issues
  » Safety – must not interfere with control inputs
  » Resolution – how much accuracy will we need
Position Sensor Options

- Linear Variable Differential Transformer
  - -35°C to 125°C
  - Up to 20g
  - Max 50,000 feet
  - 1 to 10 VAC 400 Hz

- Rotary Variable Differential Transformer
  - -55°C to 85°C
  - Up to 20g
  - Max 20,000 feet
  - 3 to 30 VAC 400 Hz

Source: Penny and Giles Website
Position Sensor Installation

- Easy accessibility
- Common location
- Best range of motion
Sensor Location Options

• Floor under the rear seat
  » Easily accessible
  » All the controls in one common location
  » May limit range of motion

• At the control surface
  » Harder to access
  » More wiring due to remote locations
  » Outside the pressure bulkhead

• On the control surface
  » Good range of motion
  » May interfere with surface movements
Sensor Locations Options (cont.)

Elevator, Rudder, & Ailerons
Sensor Locations Options (cont.)

Elevator, Rudder, & Ailerons
Sensor Locations Options (cont.)

Throttle
Analog to Digital Converter

- Monitor the control system position signals
- Digitize control system position sensor signals
- Prepare the signal for processing
  » Identify which signal is being sent
  » Tag the signal
  » Convert it for transmission
Linear Potentiometer

• Provide barometric altimeter correction to the Air Data Computer
Air Data Computer

• Provide barometric altitude to the Inertial Reference System
• Sends airspeed information to the data collection system
Data Collection System

• PC-104 serves as a platform for the Condor CEI400-44 ARINC 429 Interface Card
• Gateway Solo laptop is used as the data storage unit and runs the data collection programs
• Time stamps the collected information
  » Time stamp can be set as low as 1ms
Inertial Reference System

- Primary source of information
- Sends several parameters to the data collection system
  - Ground Speed – 10 Hz
  - Body Accelerations – 50 Hz
  - Body Rates – 50 Hz
  - Altitude – 25 Hz
  - Roll and Pitch Angle – 50 Hz
Unresolved Issues

• Method of collecting control input information
• Formatting the control input signals
• Safety issues in installing the control system position sensors
• What data to collect and what rates at which to collect it
• Coordination of control system data with aircraft response data
Conclusion

• Collecting the inertial data is a fairly straightforward process
• Collecting the control system data will require more time to develop the necessary methods and systems
Questions?