Flight Lab: calibration of control surfaces

Group D

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1 Aim of the Experiment

To Calibrate the Control Surfaces like ailerons and Elevators on airplane to construct a Scale for measurement in flight

2 Introduction

Calibration is the process of configuring an instrument to provide a result for providing sample within an acceptable range. Eliminating the factors that cause inaccuracies is the fundamental aspect of instrumentation design.
In This experiment we will determine the relationship between the control surface deflection angle and the output voltage. Calibration will be performed on Hansa-3 aircraft using inclinometers and data acquisition system. Hansa-3 is manufactured by National Aerospace laboratories, Banglore.The Calibration data is used in the other experiments like estimation of neutral point and maneuvering point. since in these experiments we need to record elevator deflection and aileron deflection.

3 Procedure

1. Fix the inclinometer on the control surface where we have to measure the output voltage of the control surface such as alierons on the wing and elevators on the horizontal stabilizers for specific deflection angle.
2. Connect the Data Acquisition system.
3. Measure the Control surface Deflection using control stick.
4. Measure corresponding output Voltage.
5. Plot a Graph With voltage on X-axis and deflection on y-Axis.
6. Draw a straight line joining the points and measure deflection.

4 Observations Record

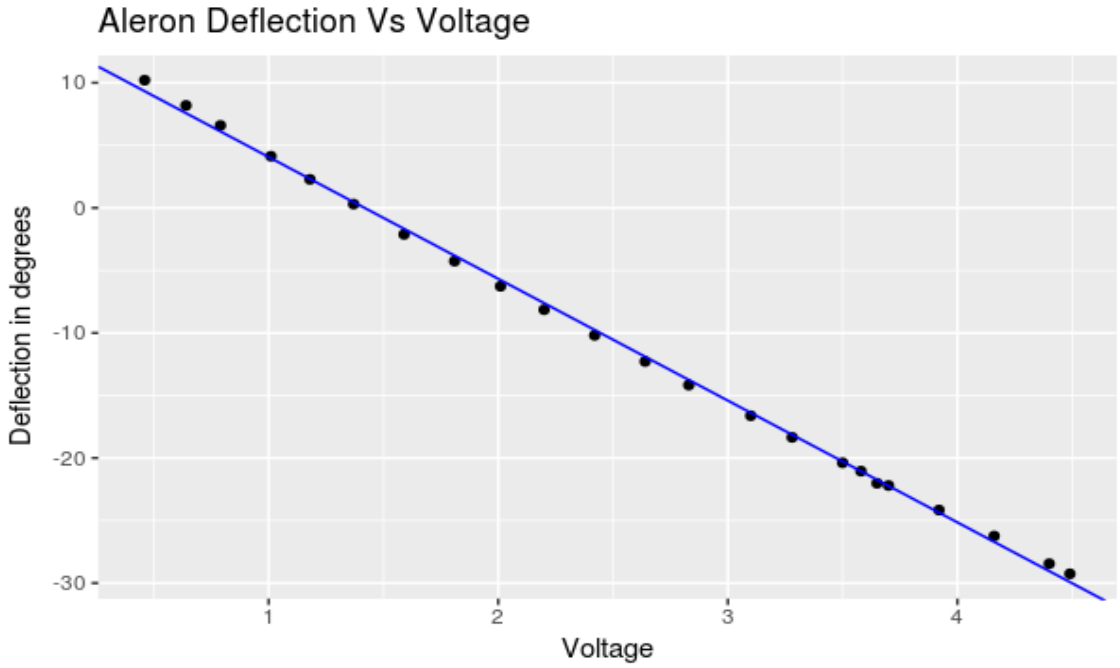
v	θ
0.46	10.21
0.64	8.19
0.79	6059
1.01	4.13
1.18	2.28
1.37	0.3
1.59	-2.12
1.81	-4.26
2.01	-6.27
2.2	-8.14
2.42	-10.19
2.64	-12.28
2.83	-14.17
3.1	-16.62
3.28	-18.35
3.5	-20.38
3.65	-22.02
3.58	-21.05
3.7	-22.2
3.92	-24.16
4.16	-26.24
4.4	-28.45
4.49	-29.26

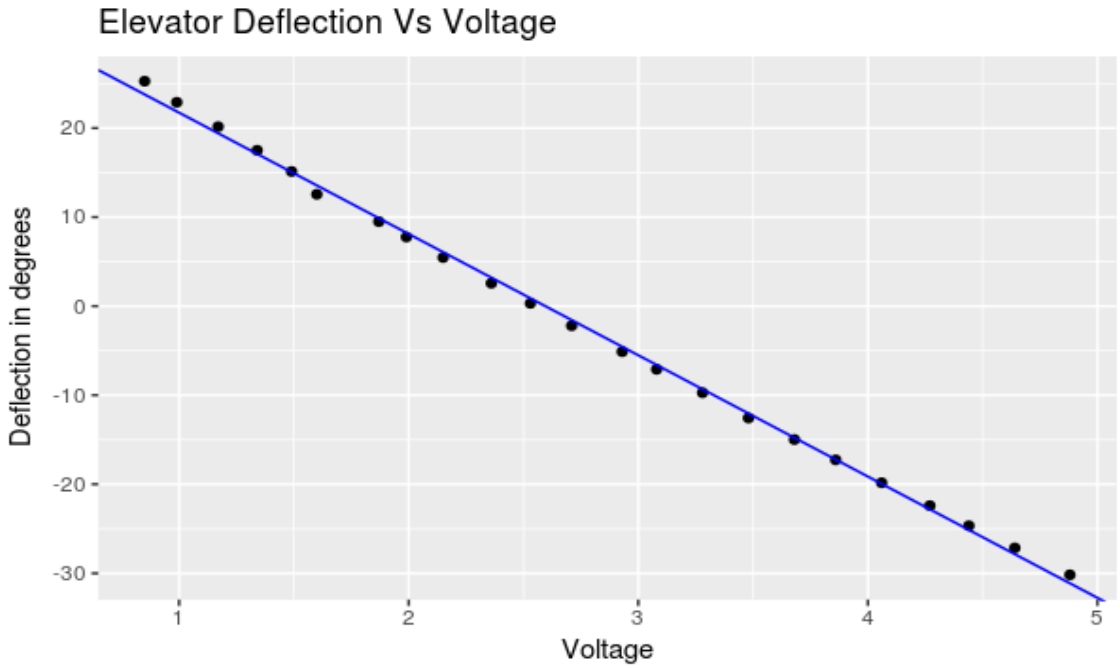
Table 1: Elevator Calibration Data

v	θ
0.85	25.26
0.99	22.89
1.17	20.15
1.34	17.5
1.49	15.12
1.6	12.56
1.87	9.49
1.99	7.76
2.15	5.46
2.36	2.57
2.53	0.31
2.71	-2.2
2.93	-5.11
3.08	-7.09
3.28	-9.72
3.48	-12.56
3.68	-14.98
3.86	-17.26
4.06	-19.83
4.27	-22.4
4.44	-24.66
4.64	-27.15
4.88	-30.17

Table 2: Alieron Calibration Data

5 Plot


Aleron Deflection Vs Voltage
Deflection in degrees
10
0
-10
-20
-30
1
2
3
4
Voltage


Elevator Deflection Vs Voltage
Deflection in degrees
20
10
0
-10
-20
-30
1
2
3
4
5
Voltage

6 Discussions

6.1 Importance of Calibration

- The calibration process generally involves using the instrument to test samples of one or more known values called calibrators. The results are used to establish a relationship between the measurement technique used by the instrument and the known values.
- Ideally a product would produce test results that exactly match the sample value, with no error at any point within the calibrated range. This line has been labeled Ideal Results. However, without calibration, an actual product may produce test results different from the sample value, with a potentially large error.
- Calibrating the product can improve this situation significantly. During calibration, the product is taught using the known values of Calibrators 1 and 2 what result it should provide. The process eliminates the errors at these two points, in effect moving the Before Calibration curve closer to the Ideal Results line shown by the After Calibration curve. The Error At Any Point has been reduced to zero at the calibration points, and the residual error at any other point within the operating range is within the manufacturers published linearity or accuracy specification.

6.2 Precautions

- Calibrators should be well maintained in order to reduce the external influences.
- Calibration should take place in secured environment to ensure minimal impact of external vibrations etc
- Random Errors produced can be reduced by producing large number of measurements and taking mean of the experiment.

7 Conclusions

- The Slope of Elevator Deflection vs Voltage plot is -13.6200. intercept is 35.3413
- The Slope of Aleron Deflection vs Voltage plot is -9.73849. intercept is 13.80354