Automated Control of a Fan used for Aeroacoustic Measurements

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INTRODUCTION

Components of aircraft environmental control systems generate aerodynamic noise. A similar setup is obtained by airflow through a test object. The airflow is generated by a fan with adjustable RPM that is controlled manually by an engineer. Due to the high number of measurement points, this is a time-consuming task. The project aims to automate this process, thus improving repeatability, reducing human error, and providing reliable data for interior noise research.

OBJECTIVES

- Understand functioning of Ahlborn measuring and control devices - ALMEMO 710 and ALMEMO 8006-RTA3.
- Set up hardware consisting of flow tube (for measurement of the flow rate), fan and establish interface with the ALMEMO devices.
- Develop an automation sequence using AMR WinControl to determine the relation between volumetric flow rate and applied fan voltage and use this to generate flow rates corresponding to specific dB levels relative to a given nominal flow rate.
- Provide an equivalent automation setup using MATLAB for enhanced flexibility.

HARDWARE SETUP

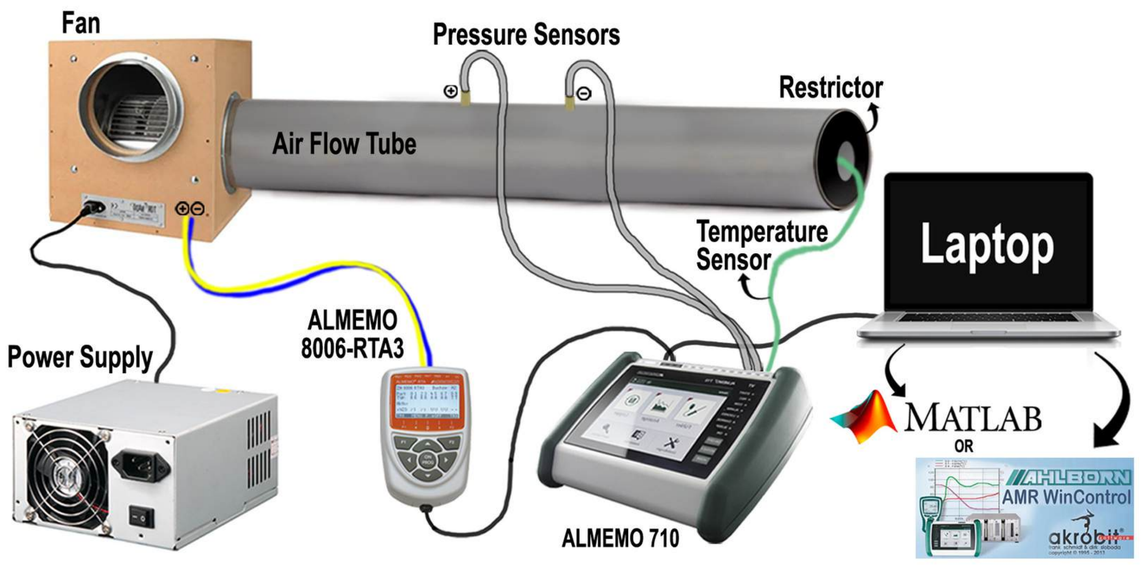

Fig. 1 : Hardware Setup of the project

AUTOMATION SEQUENCE

A) Determine characteristic relation of Volumetric Flow Rate vs. Voltage for a given test object

INPUT
- Set of voltage values
- Measuring time per data point

- Apply sequence of voltage values to fan.
- Measure temperature, absolute pressure, & pressure drop across the restrictor inside the flow tube between the pressure sensors.
- Calculate corresponding volumetric flow rates.
- Determine relation between volumetric flow rate and voltage, store measured data.

B) Achieve a Specific Set of Flow Rates

INPUT
- Nominal flow rate
- dB steps
- Number of data points
- Measuring time per data point

- Calculate target flow rate for each dB value relative to nominal flow rate.
- Determine corresponding voltage from characteristic relation.
- Apply voltage, calculate resulting flow rate, and store measured data.

RESULTS

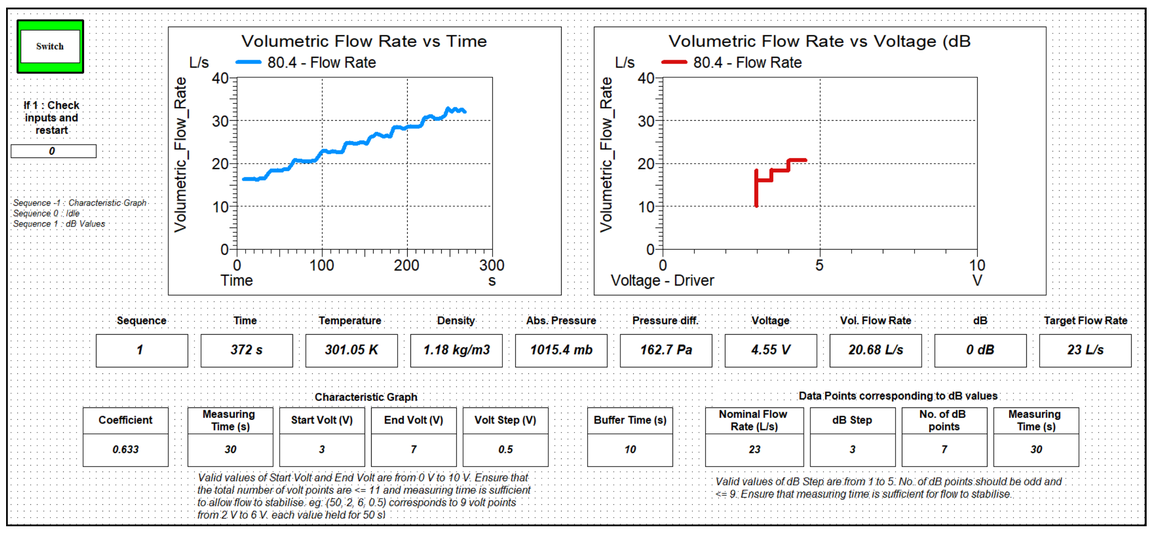

Fig. 2 : AMR WinControl GUI showing testing of automation sequence

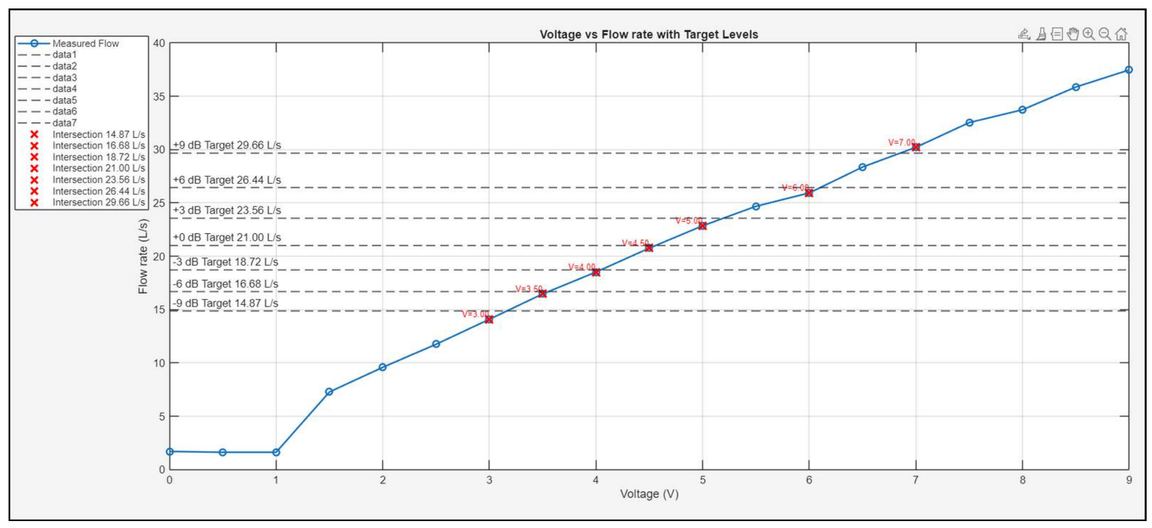

Fig. 3 : Volumetric Flow Rate vs Voltage graph in MATLAB

- **AMR WinControl** : Automation was achieved with AMR WinControl software, featuring an intuitive GUI, real-time tracking via live graphs, and automated sequences.
- **MATLAB** : Results were replicated in MATLAB by directly interfacing it with the ALMEMO 710.
- **Data Storage**: All values are saved in *.txt* and *.amr* files for post-processing. Additional graphs can be generated as required.

CONCLUSION

The project successfully automated the control of a fan used for aeroacoustic measurements, leading to a setup that offers accurate, repeatable, and consistent airflow control. Two solutions were provided, namely AMR WinControl Software and MATLAB.

AMR WinControl software allows for automatic sensor detection and communication with the ALMEMO 710. However, its limited programming capabilities restrict the extent of customizations or complex modifications.

MATLAB provides greater flexibility in programming and graphing, and allows detailed analysis of measurement data.

Team Member	Task Area	Hours
Chaitali Uday Karekar	SCRUM Master, WinControl Automation, System Integration	110
Kareem Ayman Mohamed Aly	Product Owner, MATLAB Automation, System Integration	110
Advith Channagiri Nataraj	WinControl Automation, System Integration	105
Alejandro Mon Martinez	MATLAB Automation, System Integration	101
Sobaan Ahmed	Poster and Documentation	90
Aida Memarian	Poster and Documentation	90