

Master Thesis - “Performance measurements in turbomachines , Calibration & choice of pressure probes” (30 credits/20 weeks – 1 or 2 student[s])

About us

GKN Aerospace is the world’s leading multi-technology tier 1 aerospace supplier. With 55 manufacturing locations in 15 countries, we serve over 90% of the world’s aircraft and engine manufacturers. We design and manufacture innovative smart aerospace systems and components. Our technologies are used in aircraft ranging from the most used civil aircraft to the world’s advanced 5th generation fighter aircraft and the Ariane orbital rockets used by ESA.

Project Background

Aerodynamic testing is an essential part of the development and verification of turbomachines. As the technologies mature, the improvements become in general more incremental. This imposes higher requirements to the accuracy of the measurements used in the evaluation and validation of the new designs.

This thesis project is a part of the work towards improving our test methods and developing personnel in this field. In particular, its objective is to develop know-how and capabilities of flow and pressure measurements: choice of probes, calibration, positioning of probes, traversing speed and methods for presentation and evaluation of measurement data.

Assignment Description

This project is directed towards improving our know-how and capabilities in pressure measurement in gas flows, which is crucial for performance measurement in turbomachines.

Multi-hole probes

Combination multi-hole probes are often used to get as much information of the flow as possible out of the very expensive tests. They give more than one measured parameter in one measurement: flow angles, static pressure and total pressure. This type of probes can have 3, 5 or 7 pressure taps in its tip. Combination multi-hole probes of this type require calibration and advanced processing of the raw measurement data (pressure at the different pressure taps in the tip) in order to obtain the desired flow parameters accurately (flow angles, static and total pressure). For this, it is important to have a controlled and verified procedure to achieve good and verified measurement accuracy.

To ensure this, methods are required for:

- Calibration
- Calculation of correction factors
- Application of corrections on raw measured data (post-processing).
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Comparison of multihole probe and pitot probe.

The requirements on accuracy are generally high for performance measurements and the total pressure is one of the most important parameters and hence there is a constant strive to get the best possible accuracy. Multi-hole probes are sensitive to flow angle and are hence not always the best choice for achieving the best possible accuracy for the total pressure measurements. Therefore one of the first tasks is to evaluate different types of total pressure probes. In this case we want to compare results from wind tunnel tests obtained using five-hole probe, pitot probe and kiel probe at different test conditions. The comparison shall give knowledge that will be useful in choosing probe types when setting up a test campaign.

- Guide lines for which type of probe to use for a certain task: Trade between accuracy and other parameters as probe size, flow disturbance, measurement time, cost and lead time for manufacturing/calibration.
- The project includes the design of a Kiel probe. Existing five-hole probe and pitot probe will be used.

Tasks

- Calibration of 5-hole probe in windtunnel at GKN: Collect data at different flow angles and flow speeds with the five hole probe. An existing NI-LabView based system will be used. Existing LabView program can be used or if more suitable new program will be made by the thesis worker.
- Calculate calibration coefficients: Do a computer program with LabView interface that calculates correction coefficients from calibration data (flow angle, static pressure and total pressure)
- Do a computer program with LabView interface, which is used to apply the calibration coefficients on pressure data from the 5HP probe.
- Collect total pressure data with all three probes at a range of flow angles and speeds in the windtunnel.
- Compare results from all three probes with respect to measurement error at different flow angles and speeds.

Project milestones

- Design of kiel probe ready
- Calibration test with 5-hole probe done and calibration coefficients calculated.
- Test with all three probes done and analysis done.
- Final report and documentation of test results and computer programs done.

Deliverables

- New LabView programs and documentation, including how they are used.
- Report of results from calibration test and comparisons of the the probes in terms of accuracy over a range of flow angles and flow speeds.

Qualifications

- Master's student directed towards aerodynamics and experimental work.

Apply by

Send your resume and cover letter to .

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