Master thesis and internship[BR]- Master thesis : Investigation of Analytical Models for Evaluating the Impact of Distortion on Compressor Performance and Stability[BR]- Integration internship

Auteur : Escudero Saiz, Alvaro
Promoteur(s) : Hillewaert, Koen
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UNIVERSITY OF LIÈGE - FACULTY OF APPLIED SCIENCES

INVESTIGATION OF ANALYTICAL MODELS FOR EVALUATING THE IMPACT OF DISTORTION ON COMPRESSOR PERFORMANCE AND STABILITY

Graduation Studies conducted for obtaining the
Master's degree in Aerospace Engineering
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ÁLVARO ESCUDERO SAIZ

Promotor: Mr. Koen Hillewaert (University of Liège)
Co-Promotor: Mr. Patrick Hendrick (Free University of Brussels)

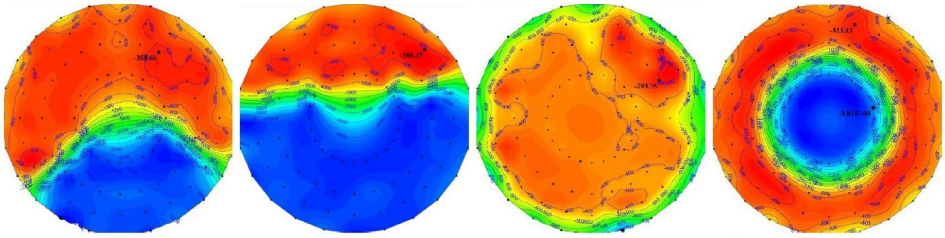
Summary

This Master Thesis summarises the study carried out to estimate the effect of different non-uniformities in performance and stability of compressors. Three types of distortion have been included: pressure, swirl and temperature. While pressure and swirl distortion may occur in both civil and military aircraft, temperature distortion uses to appear in military applications.

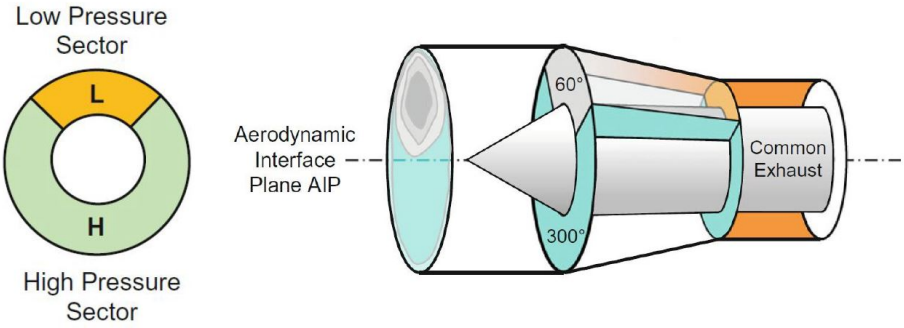
First, distortion indexes to characterise pressure distortion have been investigated, choosing CDI_{mean} to relate distortion with the behavior of the compressor. Parallel compressor model has been implemented in MATLAB and applied to two compressors from Larzac04 and PW-1128. Estimations about stability and performance in terms of surge margin and percent loss of surge pressure ratio have been done, decreasing both when distortion increases.

Later, swirl distortion has been studied. It has been defined and characterized, and then a Mean Line Code has been implemented in MATLAB to simulate how corrected speed lines change with co-rotating and counter-rotating swirl. For co-rotating swirl, pressure ratio and corrected airflow decreases, so surge margin increases but performance decreases. The engine behaves opposite to counter-rotating swirl, decreasing surge margin and increasing performance.

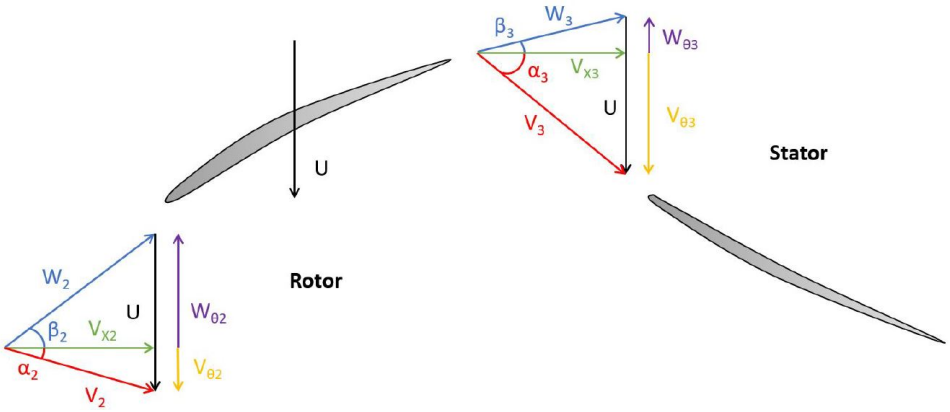
Finally, temperature distortion has been introduced and the parallel compressor model (temperature distortion version) has been implemented in MATLAB and applied to the compressor of PW-1128. In this case, good results have been obtained only for high values of corrected speeds. The main conclusion obtained was that the higher the temperature distortion, the smaller the surge margin. All these codes are included in this Master Thesis and are available to future students and researchers to continue studying this topic.



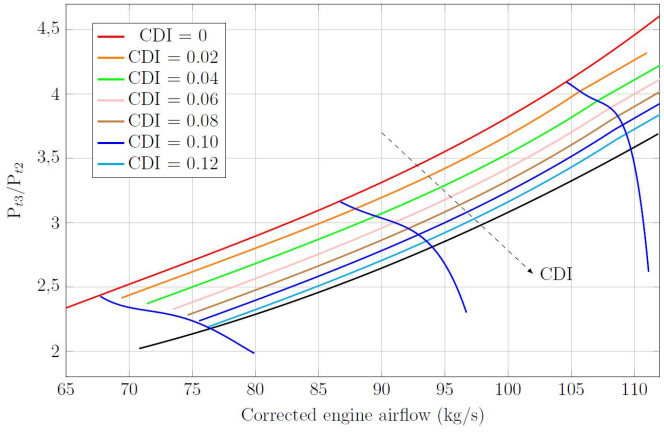
(a) Pressure maps



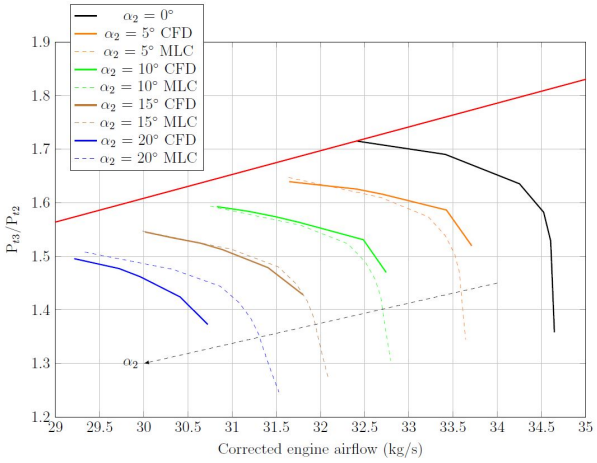
(b) Parallel compressor model representation



(c) Velocity triangles with co-rotating swirl



(d) Changes in compressor map due to pressure distortion



(e) Changes in compressor map due to swirl distortion