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PROPOSITION DE SUJET DE THESE

Intitulé : Compressor stall control using vectorized jets

Référence : **MFE-DAAA-2024-35**
(à rappeler dans toute correspondance)

Début de la thèse : 01/10/2024	**Date limite de candidature :** 30/04/2024

Mots clés

Axial compressor, rotating stall, flow control, vectorized jets

Profil et compétences recherchées

Master 2 (Université ou école d'ingénieurs) à dominante aérodynamique, turbomachines

Master thesis with CFD / turbomachinery / fluid mechanics lectures

Présentation du projet doctoral, contexte et objectif

Due to the presence of a gap between the rotor tip and the fixed casing for mechanical reasons, a clearance flow is generated from the pressure to the suction side. This flow is responsible for losses, e.g. stagnation pressure loss, which increases mechanical work and power consumption, and decreases the compressor efficiency. This flow limits also stable operating range. For some compressors, the rotating stall or the surge is due to the tip flow. For all these reasons, numerous works carried out the tip leakage flow. Among them is the topic of flow control.

This PhD proposal follows previous works and PhDs on the flow control of tip leakage flow: G. Margalida (flow control applied to CME2 compressor, 2019), B. Deveaux (flow control of an isolated blade with tip gap size effect, 2020), C. Rannou (flow control and tip gap size effect on CME2 compressor, 2023). The CleanSky2 project ACONIT (2020-2023) was also dedicated to the TRL upgrading of actuators (thermal and vibration environment. In these projects, actuators are located at the casing, upstream of the rotor blade, and the flow control relies on the Coanda effect to obtain a jet tangential to the casing. The last work of C. Rannou showed that the flow control is effective for both assessed tip gap sizes (0.6% and 2.4% of tip rotor chord), with a positive power balance (recovered power is higher than the supplied one) and, the importance of the blowing angle in relative frame. The incoming jet must be aligned with solid angle at leading edge to obtain the best control efficiency. The difficulty lies in the fact that the flow is injected into the absolute reference frame. The relative injection angle depends on the flow rate and compressor speed, making it very difficult to use the optimum angle.

Vectorized jets are a promising technology for adapting the relative blowing angle without modifying the geometry, by adjusting the phase between two injectors. The aims of this thesis work are (1) to develop vectorized jets on the CME2 compressor, identify the most influential parameters and determine their values using the experimental test bench, and (2) to reproduce the best configuration by CFD (unsteady RANS and/or hybrid RANS/LES) to better understand the dynamic of the interaction jet / tip flow.

Collaborations envisagées

LMFL

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