Università degli Studi di Napoli Federico II

Scuola Politecnica e delle Scienze di Base

Corso di Studi in Ingegneria Meccanica

CORSO DI LAUREA MAGISTRALE IN INGEGNERIA MECCANICA PER L' ENERGIA E L'AMBIENTE
(Classe delle Lauree Magistrali in Ingegneria Meccanica, LM-33)

Elaborato di Laurea

"A THERMO-FLUID DYNAMIC ANALYSIS OF AN OIL COOLING SYSTEM FOR A TURBOPROP ENGINE IN GROUND AND CRUISE CONDITIONS"

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ABSTRACT

The Master thesis has been performed during the internship program in the frame of a cooperation between C.I.R.A. (Italian Aerospace Research Centre) and "Federico II" Industrial Engineer Department, University of Naples.
The present work falls within an European project, named ESPOSA (an acronym for **E**fficient **S**ystems and **P**r**O**pulsion for **S**mall **A**ircraft) and aimed at development of technologies necessary for application of small turbine engines as primary power plant on general aviation airplane.
In this framework, the study concerns a thermo-fluid dynamic (air-side) analysis of the oil cooler system [Fig.1] installed on the aircraft designed by ESPOSA, considering two main operating conditions: ground and cruise.
These extremely different conditions are taken into account in order to investigate the two possible types of air-flow: natural ventilation in cruise condition and forced ventilation, due to the fan operation, in ground condition.
In both cases, it is verified whether the air mass flow rate is able to reject the required thermal rate passing through the heat exchanger (oil cooler) modeled as a porous medium.
Thus, using the commercial CFD software tools (Ansys Icem CFD as mesh generator, Ansys Fluent as flow solver and Tecplot 360 as data visualization), numerical simulations of flow and thermal fields are carried out, building two geometrical configurations (with a block-structured grid): "*alone*"[Fig. 2] and "*coupled*"[Fig.3].
First, neglecting the possible air-flow disturbances at upstream and downstream of the oil cooler duct, with *alone* configuration the computational domain corresponds precisely to the oil cooler duct (exploiting its symmetry plane). Unlike, secondly, with *coupled* configuration a far field, more real as computational domain, including external nacelle, wing portion and rear pusher propeller, is considered. In Figures 4 and 5 are shown some of the post-processed results.

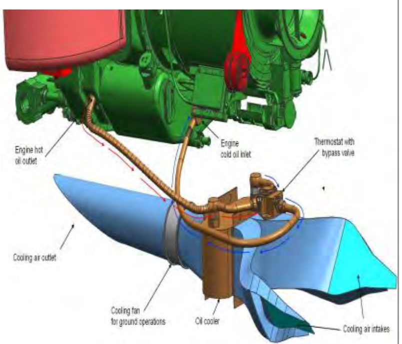

Fig. 1 Oil cooler installation, expanded view with details

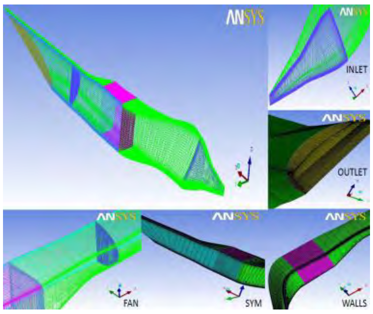

Fig. 2 Mesh overview (alone configuration)

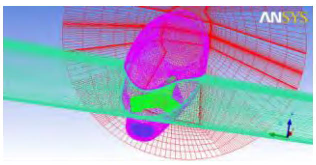

Fig. 3 Mesh detail view (coupled configuration)

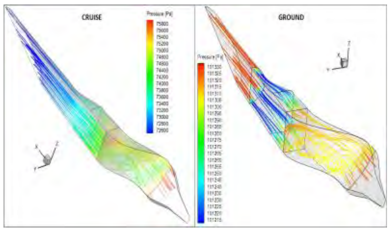

Fig. 4 Ribbon-streamlines flooded by pressure throughout the whole duct (alone configuration)

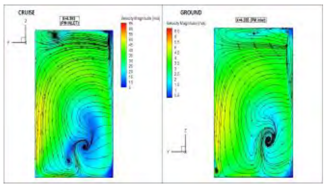

Fig. 5 Velocity magnitude and streamlines at HE inlet surface (alone configuration)

Anno Accademico 2013/2014