GKN AEROSPACE

Master Thesis - "Assessment of multiphase boiling models for modelling of heat and mass transfer in an aero engine steam vaporizer" (30 credits/20 weeks – x1 student)

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

Modern aero engines are incorporating tending to incorporate increasingly more heat exchanger technology in their thermodynamic architecture to reduce their overall specific fuel consumption as well as increase their overall thermodynamic efficiencies. An example of this is the revolutionary SWITCH[1] WET[2] engine in which the thermodynamic efficiency and specific fuel consumption of the engine is enhanced by recovery of a portion of the thermal energy usually lost in the exhaust of the core engine flow. In the WET engine, this (formerly) wasted energy is recovered by passing the core engine exhaust through a vaporizer within which water is vaporized into steam which is then expanded through a turbine fixed to the low pressure engine spool. The water vapour from the steam turbine is then injected into the combustion chambers of the core engine cycle where the so-called "wet combustion" is used to reduce the production of C02 and NOx gases.

Assignment Description

Multiphase modelling in which heat and mass transfer occurs, such as in a steam vapourizer is often computationally challenging as a result of the number and complexity of equations and models used to model the process as well as oftentimes very difficult to converge reliably. Within the computational fluid dynamics literature, a myriad of different models and approaches including Eulerian-Eulerian and VOF[3] approaches exist. As such, this thesis will entail a review of the existing literature including correlations used for liquid boiling and then an investigation of the various models within the computational fluid dynamics engineering code ANSYS Fluent. In order to validate and determine the most effective approach, the results of simulations mimicking a single pass boiling tube will be compared with experimental data derived from analygous laboratory experiments being conducted on behalf of GKN Aerospace.

- Content and milestones
  - Review of existing correlations within the literature
  - Assessment of existing heat and mass transfer models (in particular Eulerian-Eulerian (RPI) and VoF) models within ANSYS Fluent
  - Comparison of the computed results with experimental results
- Deliverables
  - A technical report or similar detailing
    - Overview of existing aerothermo calculations for water boiling
    - Assessment of the existing models accuracy and robustness
    - Comparison of the computed results with those derived from single tube boiling experiments
  - Presentation at GKN Aerospace

Qualifications

- Bachelors degree with a strong interest in aerothermodynamics and / or computational mechanics

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[1] Sustainable Water-Injecting Turbofan Comprising Hybrid-Electrics
[2] Water Enhanced Turbofan
[3] Volume of Fluid

Apply by

Send your resume and cover letter including a brief description of previous engineering experience or interests to **Jonathan Bergh**, jonathan.bergh@gknaerospace.com & **Sonny Anderson**, sonny.andersson@gknaerospace.com.

Last date for application: **As soon as possible**

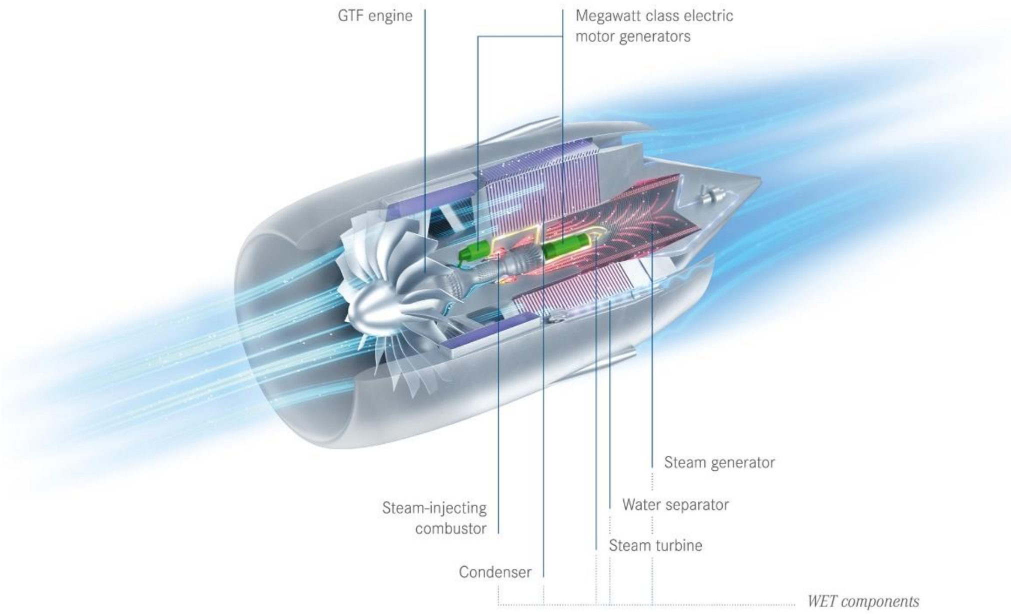
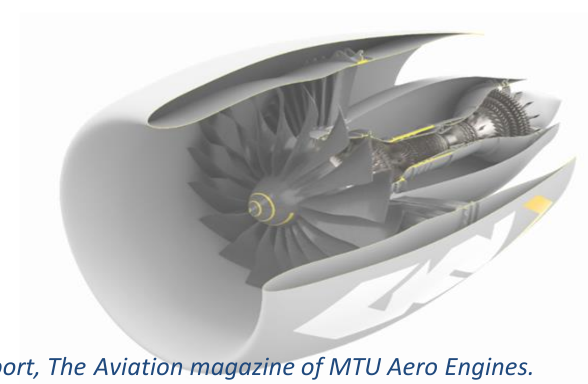


Figure 1 The SWITCH WET concept aero engine. Reproduced from [1].



[1] Henrich, I (2022). A brief guide: How the WET concept works. MTU Aeroreport, The Aviation magazine of MTU Aero Engines. Online: https://aeroreport.de/en/good-to-know/a-brief-guide-how-the-wet-concept-works. Last accessed: 05/07/2022