Bachelorarbeit

Numerical Simulations of Annular Mist Flow in Horizontal Pipes and U-Bend

Recent studies claim that the relative contribution of the aviation sector is projected to become the following years one of the primary sources of total greenhouse gas (GHG) emissions in Europe's transport sector. To tackle this challenge, MTU Aero Engines AG has introduced the WET (Water-Enhanced Turbofan) concept, aiming to minimize emissions while optimizing thermal efficiency. This new engine architecture is based on a Cheng Cycle where water is being recovered from the exhaust stream and superheated steam is injected into the combustion chamber of the engine (Fig. 1). One promising device that separates efficiently the water from the air and doesn't lead to enormous pressure losses is the U-Bend.
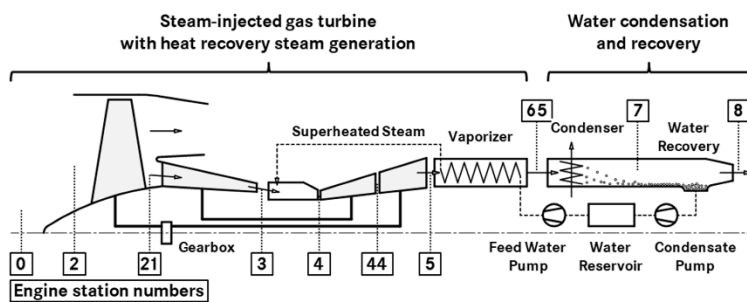

Fig. 1: Schematic depiction of the WET engine architecture.
Schmitz, O.,Klingels, H. and Kufner, P. Aero Engine Concepts Beyond 2030: Part 1-Steam Injecting and Recovering Aero Engine, Journal of Engineering for Gas Turbinesand Power, 2021, 143, (2), pp 021001.
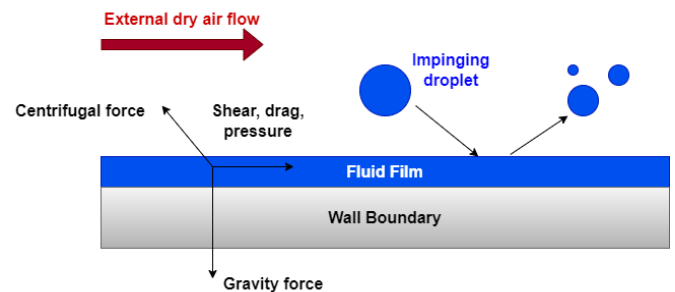

Fig. 2: Interaction phenomena between the different phases.

The two-phase flow mixture flowing through the bend, consists of air and water droplets in the annular mist flow regime and under turbulent conditions. Fig. 2 shows the interaction of all phases, including droplet impingement/entrainment with the simultaneous action of the centrifugal, gravitational and drag force on the fluid film. The aim of this thesis is to use Computational Fluid Dynamics (CFD) to develop a validated numerical model, based on the Eulerian-Lagrangian scheme, that considers the complexity of all the interaction phenomena.

Qaulifications:

- **Strong background in Fluid Dynamics Theory.**
- **Experience with CFD softwares (ideally with Star-CCM+).**
- **Analytical thinking & motivation.**

Tasks:

- Literature review.
- Mesh convergence study for the continuous and discrete phase.
- Validation of the fluid film model.
- Pressure drop CFD results comparison to correlations.
- Separation efficiency (η) estimation.

Ansprechpartner:

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