

Novel Ventilation Concepts for Long-Range Aircraft Cabins – Thermal Comfort and Energy Efficiency

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Flexible cabin layout, high demands on thermal comfort and energy efficiency as well as industrial modular design are the main challenges for aircraft engineers when addressing the ventilation of the aircraft cabins. Nowadays, standard mixing ventilation is installed in all commercial aircraft, guaranteeing a high degree of mixing and therefore a very robust and stable ventilation concept for the cabin. However, complex and weight-intensive ducts are required, the system provides only limited heat removal efficiency and high velocities are prone to cause draught on single seats.

Addressing these challenges, we are investigating novel ventilation concepts within the ADVENT project - Advanced ventilation techniques for modern long-range passenger aircraft to promote future energy management systems. Low-momentum and micro-jet based concepts integrated in the ceiling, floor or sidewall modules are analyzed. The transient numerical simulations (URANS) are based on second-order finite volume schemes. In a post-processing tool chain, thermal comfort quantities, such as predicted percentage of dissatisfied or predicted mean vote are calculated. The test configuration is a slightly simplified Airbus A350 geometry with a 9-abreast seating. At the conference, we will present and discuss temperature and velocity fields, streamline visualizations, heat removal efficiencies as well as the above-mentioned comfort indices for various ventilation configurations. First results proved the energetic advantages of displacement ventilation compared with state-of-the-art mixing ventilation. Further, different locations and dimensions of the micro-jet and trickle-ceiling air inlets resulted in locally different flow fields. Here, promising locations providing a good overall comfort with high horizontal temperature homogeneity were detected.

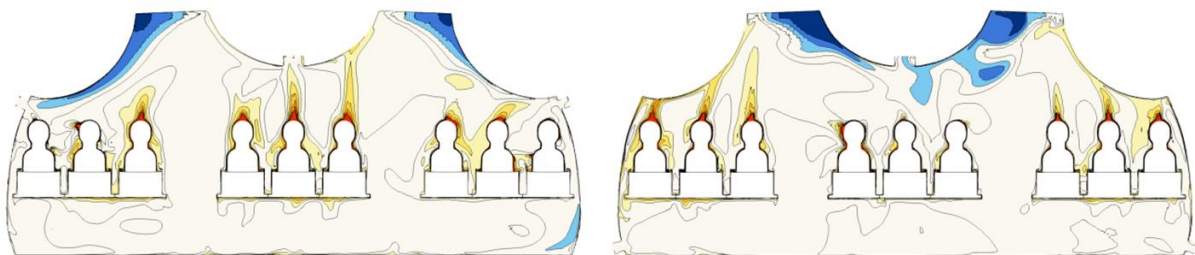


Fig. 1: Exemplary temperature contours for two different micro-jet based concepts.

Simultaneously, a new test facility is under construction at the German Aerospace Center in Göttingen. It will allow for experimental simulation of novel ventilation concepts at different flight phases (static and dynamic) promoting realistic thermo-dynamical boundary conditions.

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