Master thesis

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Evaluation of the Impact of Cooling System Designs on the Reliability of Power Electronic Systems for Aircraft Applications

Leibniz University Hanover and Brandenburg University of Technology are currently spearheading research into future electrified aircraft propulsion systems, aiming to achieve net-zero carbon emissions within the next few decades. To realize this ambitious goal, electrified aircraft propulsion systems must not only prioritize being light-weight and highly efficient but also demonstrate exceptional reliability to meet stringent aircraft safety requirements. For power electronic systems, the thermal-mechanical induced wear-out effect must be taken into account during the inverter design phase, where the cooling system design plays an important role.

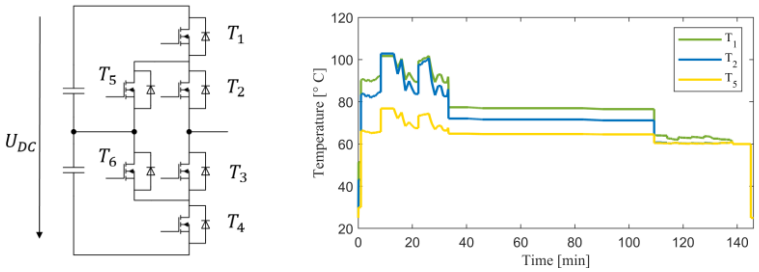

Abb. 1: Junction-Temperature profile of an ANPC-inverter in a short-range electric aircraft

This research primarily focuses on assessing the influence of various cooling system designs on the reliability of power electronic systems within a reference aircraft propulsion system. To achieve this objective, the following tasks have been outlined:

- Development of a cooling system model tailored to the specific reference aircraft mission-profile, taking into account factors like ambient temperature, air pressure, and air speed.
- Integration of the cooling system model into the existing power losses model, thermal model, and lifetime model of the power converter systems.
- Investigation of the impact of different cooling system designs on the reliability of power electronic systems. Development of mission-profile-based active cooling operation strategies to improve the reliability of power electronic systems.
- Conducting a comprehensive trade-off study, considering efficiency, weight, and reliability across various cooling system designs and operation strategies

Research focus: Reliability, cooling systems, inverter systems

	more				less
Inverter	☒	☐	☐	☐	☐
Power devices	☐	☐	☒	☐	☐
Modulation	☐	☒	☐	☐	☐
Heat Transfer	☒	☐	☐	☐	☐

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Programming	☐	☐	☒	☐	☐
Simulation	☒	☐	☐	☐	☐
Reliability	☐	☐	☐	☒	☐
Hardware	☐	☐	☐	☐	☒

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