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The Effect of Battery Size on Recharging within a Direct Hybrid Power Module

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The Systems Research Group at the Institute of Technical Thermodynamics of the German Aerospace Center has proposed a direct hybrid concept for aviation. The combination of fuel cell stacks and batteries as an energy source in airplanes has proven very promising. Within the all-electric aero plane Antares DLR-H2 investigation of the concept has begun. Past research has been focused on the operability, applicability as well as feasibility for such a power module in aviation. Both fuel cells and batteries have been applied and tested in the Antares DLR-H2. The knowledge gained was then applied to the direct hybrid concept. Recently system design, operability and safety, especially regarding redundancy, have been highlighted. In a next step recharging of the batteries from the fuel cells during medium to low load conditions were investigated. Simulations showed potential to improve the hybrid further in terms of redundancy and operational safety from an energetic point of view by increasing the size of the batteries by 30%. This implies changes in the behavior of the hybrid power module. One of the issues that must be addressed is controlling the recharging of the batteries.

The work presented, in a first step analyzes the changes due to the larger battery. In a second step possible control parameters for the charging process are investigated and strategies for the operation within an airplane are derived. Finally simulations of the new hybrid power module with simple flight profiles will be performed and the differences in terms of flight safety will be shown.

Keywords: PEM Fuel Cell, Battery, Antares DLR-H2, Direct Hybrid