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Abstract #
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Title

Overall Parametric Design and Integration of On-Board Systems for a Hydrogen-Powered Concept Aircraft

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Abstract

To reach climate neutrality in aviation, new technologies and concepts for aircraft power supply have to be considered. For regional and short-range aircraft, hybrid fuel cell systems (fuel cells and batteries) are proposed as a promising solution for aircraft power supply [1]. However, the integration of hybrid fuel cell systems and the electrification of the powertrain also affects the power supply for aircraft on-board systems, i.e. normal and emergency secondary power supply. In this context, concept studies need to be performed during the aircraft conceptual design phase to assess systems architectures and power supply strategies for hydrogen-powered concept aircraft.

In this paper, such concept studies are performed during the conceptual design phase of the aircraft, proposing a systems architecture for a hydrogen-powered concept aircraft with an estimated entry into service in 2040. The in-house *GeneSys* software framework [2,3] is being developed for overall systems design during the conceptual design phase to support system engineers by conducting such studies and evaluating the results.

To this end, relevant system sizing laws need to be adjusted and verified to perform and assess concept studies for secondary power supply for hydrogen-powered concept aircraft. In this context, the considered aircraft is the *ESBEF-Concept Plane 1* (CP1) which is derived from an *ATR 72*-like aircraft model [3]. The following steps are performed to adapt and verify the system sizing laws of *GeneSys* accordingly. First, the systems architecture of the existing *ATR 72* aircraft is evaluated. The implemented system sizing laws are adjusted based on known system parameters (e.g. mass and power consumption). Second, the systems architecture of the *ATR 72* is updated to a state-of-the-art systems architecture. Last, this systems architecture is fully electrified for the integration in the *ESBEF-CP1* and projected to an entry into service in 2040, adding technology factors to estimate improvements of relevant technologies.

To identify and select a suitable systems architecture for the *ESBEF-CP1*, architecture variants are generated and evaluated. The evaluation is performed based on safety and reliability, system masses, and power requirements. The selected systems architecture presented in this paper is the baseline for more detailed analyses, conducting, for example, time-dependent studies for energy management of the aircraft.

References

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