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C1Po3A-07: Lumped Modeling of Cooling and Electric Devices in Aircraft

Monday 19 May 2025 14:00 (2 hours)

In this work, we focused on a lumped parameter model to compare a liquid ammonia-based as well as a liquid hydrogen-based cooling system for power electronics in aircraft motors using Open Modelica. The liquid ammonia in the cooling system has a relatively high volumetric energy density and is low zero carbon. Liquid hydrogen is also of interest. It is essential for power electronics to have high-performance cooling in electric aircraft. The lumped model was designed to simulate the thermal behavior of the power electronics with respect to the cooling system under different scenarios. This model, including thermal components, describes the heat transfer between power electronics and cooling system to determine how much heat can be removed. The heat is removed using liquid ammonia, eventually dissipating in ambient air, or liquid hydrogen, eventually rejected to the bath. In our model, an individual power electronic module generates 2 kW. There are 18 power modules needed to operate one electric motor with an accumulated total of 36 kW. Then, we considered the effect of adding transmission lines and a motor in this thermal balance model.

Authors: Mr KWON, Jin; SUMPTION, Michael; ZHANG, Xianhao; Mr GUO, Yang (The Ohio State University)

Presenter: ZHANG, Xianhao

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