Safety battery management system and monitoring tool for airborne systems

Degree programme: Master of Science in Engineering | Specialisation: Energie und Umwelt
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This work is about developing a new concept and its implementation for a battery management system (BMS) which is used in aerobatic airplanes. The main goal is to design the BMS according to aircraft standard practices and the main focus is on functional safety. The realisation of requirements capture, safety concept and hardware implementation was accomplished at the ESReC (BFH) in Biel. Finally the developed hardware has been verified by a measurement under real conditions.

Project evolaris

Since the 1950s only few changes have been made on the combustion engine for airborne systems, their technique is outdated. A concept for a new propulsion system seems to be overdue. Meanwhile over the last few years developments only took place for light aircraft with a drive power around 80kW. But there weren't any specific developments made for aerobatic aircrafts. Aerobatic airplanes have a high power demand and for this reason consume a lot of fuel and are very noisy. Because of the high settlement density in Switzerland aerobatic flights collect many complaints and are therefore constrained by the government.
The higher maintenance costs and increasing prices of fuel provoke a change to alternative propulsion. An aerobatic flight does not only satisfy the pilot's activity, it also improves routine and aeronautical skills. It is for these reasons the evolaris project was initiated in February 2015. Its key aim is to develop the first electrically driven aerobatic airplane to demonstrate the possibilities of an electric propulsion unit.

Realisation

The main goal was to develop a functional safety BMS which mainly monitors the cells. The BMS must be able to detect any failure – without causing a motor or system shut-down.

The safety concept bases on the fact that the pilot is the last instance who is able to shut-down the battery. Therefore the task to deliver reliable information about the battery's condition to the pilot is of vital importance.
The work is divided into:

- Safety and risk analysis according to aircraft standard practices
- Evaluation and testing of suitable battery cell technology
- Draft and detailed design of the complete BMS hardware
- Hardware tests of all designed PCB's
- Implementation of the final hardware into the battery
- Design and implementation of a monitoring tool on the PC
- Testing and implementation of the hardware on the final battery

Results

During the thesis 80% of all critical functions of the BMS were successfully tested and verified.
Before the maiden flight takes place the rest of the relevant functions will additionally be tested and the battery will undergo further electrical and mechanical tests.Furthermore the developed BMS represents a universal platform which can be easily adapted to other projects where functional safety is a crucial point.

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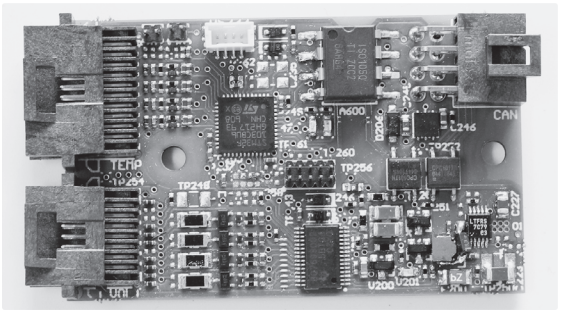
Votec evolaris at the AERO 2017 exhibition in Friedrichshafen



Developed cell data measuring PCB (slave-module)