AeroLinX – Telemetry Data Link (Team 2/2)

Development of an aircraft-to-ground data transmission system

Graduate

Flavio Willimann

Robin Kuhn

Introduction: A major concern in aviation is the negative environmental impact associated with the use of conventional propulsion systems. To tackle this problem, the Cellsius association is conducting new research into the future of aviation as part of ETH Zurich's focus projects by developing environmentally friendly propulsion systems for aircrafts. The challenge here is that the innovative drives require intensive monitoring by specialized personnel during the flight test. Therefore, various data from the powertrain must be transmitted to the ground station during the flight, which is the focus of this bachelor's thesis. The aim is to develop a cost-effective overall system, which records the aircraft's data and transmits it to the ground station at a minimum data rate of 100 kbit/s over 20 km and stores it in an Influx database.

Approach / Technology: To enable wireless data transmission from the aircraft to the ground station, it was determined that a 2.4 GHz radio transmission system would be most suitable. Based on this determination, appropriate RF transceivers and antennas were identified. Due to legal requirements, the system must be designed as a directional radio. This requires that the high-gain antenna of the ground station always remains aligned with the aircraft.

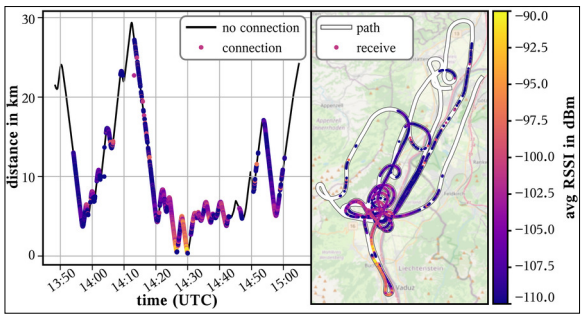
To ensure an optimized system design, during this study three iteration stages were run through. In each stage, both components and circuits were verified to maximize the functionality of the system. The prototypes developed in the process also served as the basis for programming, which meant that the software was already extensively developed at an early stage.

Result: Three subsystems were developed as part of the work: an air station for data acquisition in the aircraft and transmission to the ground station, a receiver module for receiving the data from the air station and a processing unit for storing the data in a database and directing the high-gain antenna. For simple and intuitive operation, both the air station and the processing unit were equipped with a touchscreen display.

The overall system was validated in a flight test, in which data was successfully transmitted over the required distance of 20 km. The guidance of the directional antenna was also tested, for which various tracking methods can be used. In addition, the difference in performance of an alternative placement of the transmitting antenna was analysed as a possible improvement. The reliability of the transmission could thus be significantly increased, while reducing the risk of the tracking system's failure.

Ground station during a test
Own presentment

Evaluation of the flight test
Own presentment



Comparison of the transmitter position
Own presentment

Advisor
Prof. Dr. Matthäus Alberding

Co-Examiner
Prof. Dr. Martin Stöck

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Project Partner
Cellsius, 8600 Dübendorf, Zürich