Flight optimization of the smartflyer hybrid airplane based on weather data

Degree programme: BSc in Micro- and Medical Technology | Orientation: Robotics
Thesis advisors: Prof. Dr. Gabriel Gruener, Dr. Thomas Niederhauser
Expert: Philipp Glocker (smartflyer)
External project partner: smartflyer AG, Grenchen

The start-up smartflyer has a unique project: a hybrid plane with an electric motor for propulsion and a combustion engine to recharge the batteries. An optimization algorithm plans a flight to minimize either the flight time or the consumed energy, according to parameters fed by the pilot. During the flight, the plan may be updated based on actual measurements and weather data.

Introduction

Electric propulsion for transportation has been the most important innovation in the last decade, especially in the car industry. The smartflyer team brings this innovation to the aeronautical world. As battery capacity is still limited, a hybrid solution is used.
The plane transports up to 4 passengers on a distance of 500 NM (920 km) at a maximal speed of 120 kt (220 km/h). The first prototype will be built in 2019. First flight is planned for 2020.

Objective

A given flight is to be optimized in duration or fuel consumption according to various parameters: the departure and arrival airfields, the wind according to weather forecasts as well as the cruise altitude and speed. The mass of the plane is also taken into account, depending on the number of persons on board and the cargo. Since the plane prototype is being built, some values are estimated. During the flight, the plan is dynamically adapted by the onboard computer using real-time flight measurements, such as indicated air speed, altitude and energy consumption.

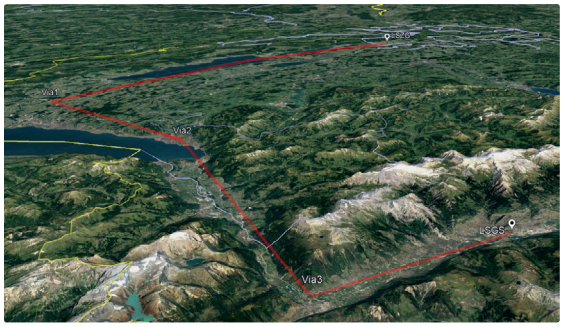
Methods

A model of the flight is developed in MATLAB, as well as the optimization algorithms. A Monte Carlo analysis is applied to the model to better understand the influence of each parameter on the flight time and the energy used. For the dynamic model adaptation, inputs are simulated since the airplane is not yet built. The code is then ported to C++, including a GUI accessible via a web page.

Outlook

The influence of the parameters will be verified during test flights. The confirmation of the correct implementation of the dynamic flight plan adaptation may be tested on a similar plane as smartflyer's.
The capacity of the battery declines with the numbers of charging cycles. This will affect the flight planning and shall be further studied. The flight plan may also be more dynamic, automatically looking for possible via points.

Cyril Dominic Albrecht



Computed flight path from Grenchen (LSZG) to Sion (LSGS) via Lausanne-Montreux-Martigny.

Batteries, combustion engine and electric motor placed inside the airplane.