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Application of Wind Measurements by Multicopter RPAS

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Multicopter Remotely Piloted Aerial System (RPAS) recently have become a reliable tool for ABL investigations. They have been operated in order to sample the vertical or horizontal structure of the ABL. Sampling the wind field and turbulence of the ABL is the domain of fixed wing RPAS as rotary wing RPAS have the inherent disadvantage of a down wash created by the rotating wings. Nevertheless, it seems desirable to sample the wind conditions locally whereas fixed wing RAPS measurements average on the spatial scale. The objective of this work is therefore to improve the wind measurement capabilities provided by rotary wing RPAS.

We have successfully operated temperature, surface temperature and humidity sensors in our campaigns since 2011 and recently complemented this with a wind sensor. In the meantime, a second wind sensor design was developed and tested. The AMOR RPAS is designed to fly in rough conditions including low temperatures down to -40 °C. A Pixhawk autopilot controls the onboard components by reading sensor data (IMU, GPS) and controlling the four motors. The standard takeoff weight is approx. 3 kg, the MTOW 4.9 kg. Depending on the battery capacity, the flight time is from 15 min (MTOW) to approx. 1 h with a standard sensor package.
The sensor package consists of a HYT271 humidity and temperature sensor (factory calibrated), a 25 micron thermocouple, a Melexis MLX90614 surface temperature. If required, a wind sensor package can be mounted. The wind sensor works according to the hot wire principle and is mounted at the end of a horizontal rod. The length of the rod is chosen to prevent any downwash to interfere with the wind measurements and therefore strongly depends on the RPAS and its payload. The data analysis has to take into account the horizontal, vertical and angular movements of the RPAS in order to get the ambient wind.
The wind sensor has been used during the New European Wind Atlas (NEWA) campaign 2016/17 around the Roedeser Berg near Kassel (Germany). The objective of the RPAS flights were to estimate the Froud number for the air flowing over and around the Roedeser Berg. We will present the characterization of the wind sensor and some preliminary results from this campaign.
Based on the experiences with the previous wind sensor, a new type was designed and characterized. The new type provides 3D wind information and includes a set of T and RH sensors and an IMU. It is mounted on two horizontal rods pointing forward and backward.