EMS Annual Meeting Abstracts
Vol. 10, EMS2013-712, 2013
13th EMS / 11th ECAM

Development of a Hungarian meteorological UAV system: instrumentation, test flights

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Development of Hungarian meteorological Unmanned Aerial Vehicles (UAV) System with on-board sensor setup started 2012. The research programme includes in situ measurements using high sensitivity on board sensors for model evaluation and further analyses.

The UAV System we use is a multi-purpose Unmanned Aerial System (UAS) designed and built by the BHE Bonn Hungary Electronics Ltd. The main features of the aircraft are the following: 16 kg total weight, 3 kg maximum payload, electric propulsion, 60-90 km/h IAS cruising, approximately 60 minute endurance. The aircraft is equipped with a two-way data communication system with a range of 15-20 km. The aircraft can be piloted either by a remote operator or by an on board automatic robot control system. The aircraft has equipped with several meteorology sensors.

The sensor system is composed of actually two, but in the near future three or more units. One unit is the “central unit” which contains a Beaglebone single-board computer, a battery and some additional circuit. This unit realizes the on-board data processing, the data logging and the real time data transmission to the ground station (the data transmission is under construction). This unit is installed in the middle (so called cargo bay) of the UAV, and connected via cable to the sensor units. The other unit is the “sensor unit” containing a 9 DOF inertial measurement unit (ArduIMU+ V3), a temperature sensor (TMP102), a humidity sensor (HIH-4030) a GPS (50 Channel GS407 Helical GPS Receiver) and a 4 channel 16 bit AD converter (ADS1115). This sensor unit is placed in the upper-nose part of the UAV. An external temperature-humidity sensor (Vaisala HMP45) can also be attached to the sensor unit. A future, third, sensor unit, currently under construction, will be the 5-hole probe (with Sensortechnics HCLA pressure sensors) mounted in an aluminium support on the nose of the UAV.

The initial sensor setup includes the measurement of temperature, humidity, pressure, groundspeed, air-speed, orientation, and gravitational forces. In the near future, the purchase of radiation carbon dioxide and ozone sensors are planned. The laboratory test and calibration of a 5-hole probe for time-resolved velocity vector measurements, developed by the Budapest University of Technology and Economics has also been initiated. Application of this probe and a thermocouple sensor (for the fast detection of turbulence features) is the next planned step for the detection of momentum and sensible heat turbulent fluxes.

Test flights of the aerial meteorological measurements were started in 2012 fall. First steps were the detection of wind, temperature and humidity (Vaisala HMP45) vertical profiles in the lower 1-2 km layer of the planetary boundary layer. Some preliminary results (planning of the survey program, profiles and WRF model comparison) will be presented.