Improving the Performance of the MASC using a Pixhawk 2 Flight Controller

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MASC (Multi- Purpose Airborne Sensor Carrier)

UAV for in-situ measurement of the boundary layer
Fine wire resistance thermometer
Capacitive humidity sensors
Five-hole flow probe
Inertial measurement unit (IMU)
GNSS position and velocity
ROCS Autopilot

Attitude control with ailerons and pitch

Fixed airspeed of 25 m/s regulated by airspeed sensor

Groundstation software with telemetry uplink for waypoint planning

Reliable flight control in windy conditions

Controlling altitude with static pressure sensor
Pixhawk 2 Flight Control System

Open Source Hardware (Pixhawk) and Software (Arduplane)

PIXHAWK Project: Computer Vision and Geometry Lab of ETH Zurich (Swiss Federal Institute of Technology)

Arduplane originated in 2007 and is used on a wide range of hardware
Pixhawk 2 Features

Triple-redundant **heated** IMU (Inertial Measurement Unit)

Internal IMU damping

Full control of ailerons, pitch, yaw

Customizeable flight behaviour (speed, roll angle etc.)

Full control over all parameters with open source firmware

cm- accurate navigation with RTK GPS
Groundstation Features

- Long-range telemetry with 433 Mhz
- Half-dipole antennas
- Real-time graph of flight data
- RTK GPS correction (cm-accurate navigation)
- Scripts for automated flight planning
Automated Generation of Flight Patterns
Autopilot Tuning

A tuning process is performed for each airframe to achieve good data quality.

Pitch, roll and yaw angles are regulated by a PID Controller.

Tuning of the PID controller is automated.

Airspeed sensor was calibrated in a wind tunnel.

The response of the autopilot to speed changes also has to be tuned.
“Racetrack”: Straight flight at constant speed and altitude between two waypoints; parallel to wind direction
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New Possibilities with the Improved MASC

Terrain following flights over an escarpment
New Possibilities with the Improved MASC

Simultaneous measurements with multiple UAV
Measurements in direct vicinity of wind energy turbines
Any Questions?

(Also now possible: Flying in extremely low temperatures)