Aerial Sonic Anemometry - Preliminary results

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Project Outlook

Actual wind turbines reach heights above 200 m and are a quite expensive type of equipment. The choice of the location for installing a wind turbine or wind farm, is also becoming a more complicated issue. The goal is to characterize with greater detail the mean and turbulent flow field over a certain area. This is achieved nowadays with point measurements of the wind characteristics with meteorological towers equipped at several heights. This standard technique is becoming increasingly expensive and technically more challenging, once the 30-50 m met towers used in the 90's were replaced by 80-100 m met towers in the 2000 decade. The standard in the wind industry is assessing the resource where it's going to be extracted (location and height). For such large turbines, where the hub is at 120 m a.g.l. it is quite expensive and technically complicated to measure with standard met towers. Alternatives ground based remote systems are being used such as LIDARS and SODARS. Complementary techniques are being developed using measuring equipment in aerial platforms like: kites, airships, balloons and plane models. Sonic anemometers proved to be a reference equipment in wind measurements and are accepted in the wind energy community when installed in masts.

This project intends to use sonic anemometers in a airborne platforms to get wind information over the flying area between met masts or waypoints.

Development

Airframe

Objectives:
Construction, adaptation and use of sonic anemometer installed in aerial platform

Instruments and logging devices

Ultrasonic Anemometer/Thermometer

- Commercial models
- In house development for specific purposes

Logging devices

- In house development for specific purposes

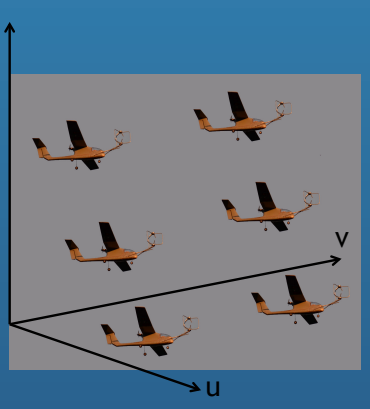
Autopilot

Under selection of different solutions - commercial or research equipment. Open to suggestions...

Finality

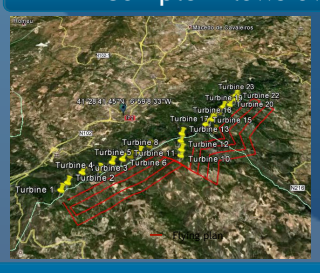
Scale-up

More than 1 sonic measuring simultaneously



Measurements

Complex flows over complex terrain

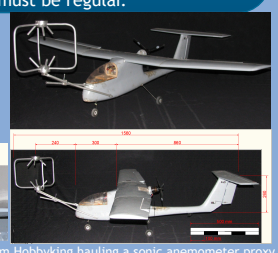


Sonic anemometer in the plane Location concerns:

- Flow distortion from fuselage can influence sonic anemometer measurement of wind fields. CFD models and wind tunnel will be required.
- The massive structure of a sonic array causes distortion in the flow over the plane.
- The plane aero dynamical behaviour must be regular.

Propulsion Location

front	
wings	?
middle	
aft	



Plane specifications:
Wing Span: 1660 mm
Fuselage: 1190 mm
Motor Mount Diameter: 58 mm
Dry weight: 1300 g
Wing Area: 3210 cm²

Model plane FPV-168 from Hobbyking hauling a sonic anemometer proxy

Aircraft control tests

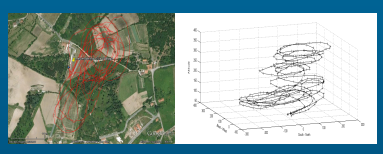
To get the maximum control of the plane 8 flying tests were done in order to determine the most suitable centre of gravity point. This is an important issue that lead to an easier flight control and will be even more important for automatic flight control systems.

Perfectly controlable in dificult situations:
- Landing;
-Take off.

Flight results

Endurance flight tests with 1 and 2 batteries were done with success using an etrex Garmin GPS for track logging. With 2 batteries the payload limit was reached.

	Maximum Velocity (m/s)	Mean Velocity (m/s)	Mean Sample Rate (Hz)	Flight Time (mins)	Distance (m)
1 Battery Flight	27,18	17,66	0,41	11:48	12663
2 Batteries Flight	23,56	15,80	0,39	9:38	9209



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