Increasing persistence of UAVs and MAVs through thermal soaring

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ABSTRACT

This work looks to harness atmospheric energy through thermal soaring to optimise the flight persistence of MAVs. There are two key challenges when considering thermal soaring, the first being the locating of thermals and the second being the extraction of the maximum potential energy from the thermals. Thermal location is by no means an exact science with experienced glider pilots needing to consider many factors to improve the probability of encountering a thermal. As thermals are caused by the uneven heating of the earth's surface it is however possible to predict likely thermal locations. With the application of a suitable guidance algorithm which considers these 'hot spots' it is possible to increase the likelihood of encountering a thermal. Once a thermal is found it is important to attempt to extract the maximum energy from the thermal. To do this the vehicle needs to move quickly to the centre of the thermal. There are many potential techniques for thermal centring, some of which appear to be entirely contradictory to each other, the crucial factor determining the success of such a technique has been found to be the response time of the onboard sensors. This paper considers the many aspects of thermal soaring such as locating thermals, thermal detection and thermal centring. Five different thermal models are presented which are used to demonstrate the thermal centring techniques. Finally a commercial glider simulation package is used to demonstrate the control architecture and simulate a fully autonomous flight.

BIOGRAPHY

Ian Cowling is a Senior Scientist at Blue Bear Systems Research (BBSR). Ian joined BBSR in 2007 after completing his PhD at Cranfield University where he researched optimal guidance and control for a quadrotor UAV.

Mike Roberts is an experienced glider pilot with 900 hours of gliding experience and a Senior Systems Engineer at Cambridge Unmanned Ltd.

Dr Simon Willcox is a Principal Engineer at BBSR with experience in the design of miniaturised hardware for UAVs and MAVs, guidance, navigation and control and, software.

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