Design and Flight Testing of a Bio-Inspired System to Remotely Sense and Track Pollution Sources for Unmanned Aerial Vehicles

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Abstract:
There is an increased interest on the use of Unmanned Aerial Vehicles (UAV) for environmental research, track bush fires, volcanic eruptions, chemical accidents or pollution sources (Farrell 2005) (Porter 2012) (Smídl & Hofman 2013). The aim of this paper is to describe the theory and results of an unmanned aerial system that uses a plume tracking bio-inspired algorithm. Simulation results proved that the plume algorithm was able to locate the source of the plume. The algorithm was tested with thousands of simulations with a success rate of finding the plume of 98.8%. Testing also inspected how the algorithm handled different wind directions with a 90% success rate when the wind direction was within 10 degrees. Hardware in the loop (HIL) testing was used to test the algorithm with the hardware components before flight testing. The testing lead to the development of a yaw controller and allowed a view of how the UAV would respond to the different modes of the algorithm, such as the vertical and horizontal search functions. The project has gone through initial flight testing where the algorithms control of the UAV during the previously mention modes was monitored and fine tuned with data from the C02 sensor being gathered. The project is now ready for full scale flight testing with controlled plume sources.

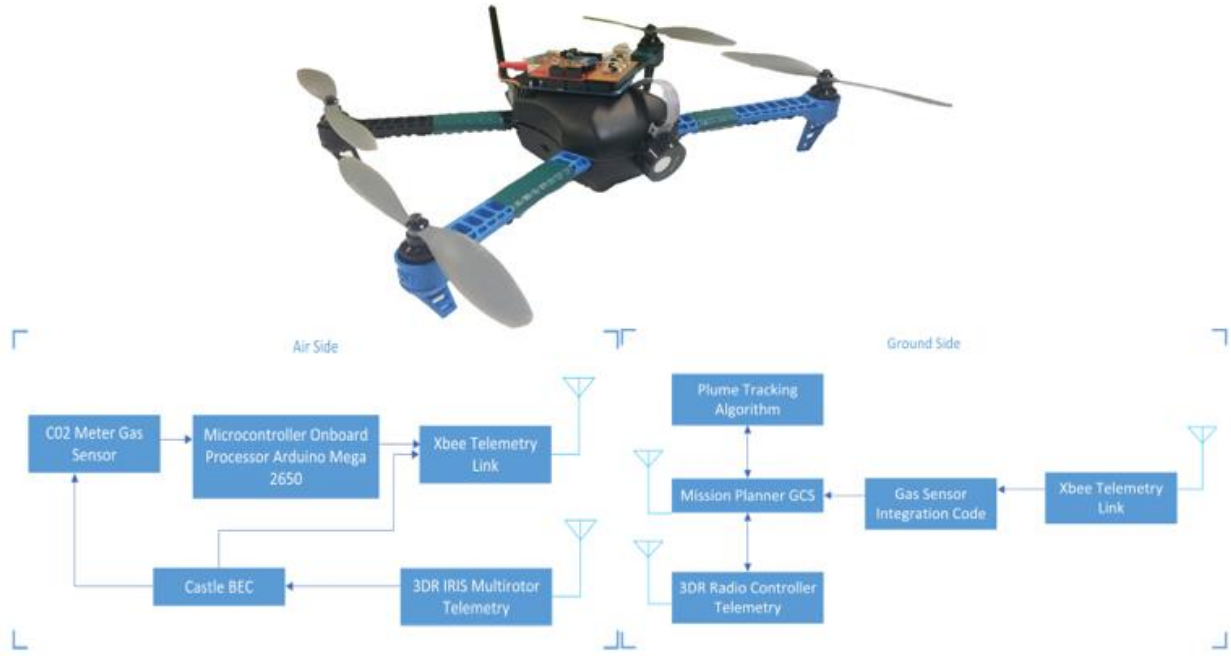

Figure 1. System Architecture with Flight System.

References:

Farrell, J. A 2005, 'Chemical plume tracing via an autonomous underwater vehicle.', IEEE Journal of Ocean Engineering, 30(32), pp. 428—442.

Porter, M. J 2012, 'Bio-Inspired Odor-Based Navigation', BiblioScholar.

Smídl, Václav and Hofman, Radek 2012, 'Tracking of atmosphere release of pollution using unmanned aerial vechicles.', Atmospheric Enviroment, Elsevier.