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AWEsome: An Airborne Wind Energy Learning Platform Using Open Software and Open Hardware

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AWEsome (Airborne Wind Energy Standardized Open-source Model Environment) [1,2] is a test platform for airborne wind energy systems that consists of low-cost hardware and is entirely based on open-source software. It has been implemented on two different flight control platforms and tested on two different model plane airframes. It can be used without the need of large financial investments (< 1000 $), in particular by research groups and startups to acquire first experiences in their flight operations, to test novel control strategies or technical designs, for academic student training or competitions, or for usage in public relations and for raising awareness for AWE.

The system consists of a modified off-the-shelf model aircraft that is controlled by the pixhawk autopilot hardware and the ardupilot software for fixed wing aircraft. The aircraft is attached to the ground by a tether. We have implemented new flight modes for the autonomous tethered flight of the aircraft along periodic patterns. We present the principal functionality of the algorithms, a simulation environment to test and develop the flight controller, and report on first successful tests of these modes in real flights [3] and on the analysis of the flight data.

In addition to using the flight control software Ardupilot, some of the original flight control algorithms of the AWEsome project were implemented in the PX4 software.

A tether coupling mechanism was designed, leading the tether vertically through the fuselage. The ability to release the tether offers more safety in critical flight situations and for landing, which has been proven in test flights.

Tethered test flight of an AWEsome vehicle, Stuttgart.

References:

[1] https://awesome.physik.uni-bonn.de

[2] https://arxiv.org/abs/1704.08695

[3] https://www.ifb.uni-stuttgart.de/en/institute/news/videos/Airborne-Wind-Energy-Successful-test-flight/]