Aerospace Europe Conference 2023
Joint 10th EUCASS – 9th CEAS Conference

Abstract #XXX *(to be filled by the organizers)*
Preferred Topics: UAVFUT / SUSTSP
Corresponding author: PECHO Pavol
e-mail of corresponding author: Pavol.pecho@fpedas.uniza.sk
Type: Oral
Status or corresponding author: Regular
For student corresponding author: student member of one of the following:
~~3AF / AAAR / AIAE / AIDAA / CzAeS / DGLR / FTF / NVvL / PSAA / RAeS / SVFW / EUROAVIA~~

Title

Design of an Unmanned Return Module for the Conditions of Stratospheric Phenomena Measurements

Authors

Pavol PECHO [1], Raffaello Mariani [2], Martin Bugaj [3], Jakub Jackuliak[4]*

** Corresponding author*
[1] *Air Transport Department, University of Zilina, ZILINA, Slovakia, pavol.pecho@fpedas.uniza.sk*
[2] *Department of Aeronautical and Vehicle Engineering, KTH Royal Institute of Technology in Stockholm, STOCKHOLM, Sweden, rmariani@kth.se*
[3] *Air Transport Department, University of Zilina, ZILINA, Slovakia, martin.bugaj@fpedas.uniza.sk*
[4] *Air Transport Department, University of Zilina, ZILINA, Slovakia, jakubjackuliak239@gmail.com*

Abstract

The aerological observations are one of the key daily routines performed by meteorologists that provide the essential meteorological data, such as pressure, temperature, humidity and wind of the upper-air to about 30 kilometres from the surface. The standard procedures are based on the single-use probes that are deployed into the air by a weather balloon which burst at the certain height and most often in position that is significantly distant from the take-off position. Usually, no effort is made to search for the probe after the meteorological data has been received and after the balloon has burst. In a world where sustainability and reuse of components and equipment are emphasized, the challenge is to ensure reuse of these probes and avoid environmental pollution. The autonomous stratospheric glider project aims to the design, construction, and experimental verification of an unmanned aerial vehicle performing the function of a return module capable of flight in the stratosphere. The principle of flight is the ability to return independently to the place of take-off, respectively to a specific destination. In cooperation with the Slovak Hydrometeorological Institute, a return module was created and adapted based on the required aerodynamic properties. These include the ability of a stable flight at high speed in the stratosphere and at the same time high penetration, due to strong headwinds occurring in the upper layers of the atmosphere. The glider is deployed analogously to aerological probes using a weather balloon. For this reason, the mission time is relatively long, therefore, the research is also focused on testing the resistance of control components to extremely low temperatures. The key factor is the creation of automatic regulation of the internal temperature in the glider based on independent monitoring of the surrounding parameters. The system prevents undercooling of the control components, which are optimally stored depending on the sensitivity to external influences.

The result of the research is the creation of a fully functional prototype, which was experimentally tested in harsh conditions with an implemented aerological probe commonly used in the practice. In addition, such return module is not suitable only for meteorological measurements but could be used for any measurements. The main advantage is the exclusion of probes finding process after their launch, as they return to their destination. These are primarily applications where the emphasis is placed on the time to find the probe. The presented research is aimed at identifying the applicability of the given solution, its optimization and proposing a practical implementation for users who do not have experience with the unmanned aerial vehicles at a professional level.