03 - Wildlife and environment protection: Autonomous quiet aerial surveillance system

Biodiversity preservation, ecosystem services, and climate change mitigation are among the vital functions performed by a healthy ecosystem. With the current rise in global temperature, it is crucial to ensure the protection and conservation of natural reserves and other designated areas. In order to protect and maintain wildlife in nature reserves, outside influences such as poaching, wildfires, and littering need to be mitigated. Covering a large area with minimal disturbance to the wildlife is challenging for ground vehicles or stationary systems. Therefore an autonomous aerial vehicle is most suitable to operate under these circumstances.

Project Objective

This project aims to design an autonomous and quiet aerial surveillance system with integrated sensors and data processing capabilities capable of wildlife monitoring, performing orography, and detecting environmental threats and litter.

System Design

To design an autonomous drone, several design steps were taken. First of all, a market and theoretical analysis were performed to explore the competitors and possibilities in the market. With these in mind, some preliminary concepts were generated. The concepts were analysed on performance, capabilities, and price of competitive products. More detailed concepts were generated from the best-performing preliminary concept, which was analysed more thoroughly. The best concept and most suitable instrumentation were selected, after which a detailed design phase commenced. This phase consisted of an analysis of aerodynamics, flight performance, noise, power & propulsion, stability & control, and structures. In the wake of the first set of detailed analyses, a comprehensive design was found that satisfied the requirements. This design was modelled in Catia V6 and can be found in the included figure. The design consists of a blended wing body, which allows the integration of the instrumentation and the pushing propeller. Two booms are attached on either side of the wing. These booms allow the placement of the four propellers that will be used for vertical take-off and landing. Next to that, a tail is placed at the very end of the booms for improved stability and control. The landing gear, which is also fixed to the booms facilitates automatic contact charging. The noise analysis was performed and resulted in a DEN noise level below 40 dBA. Furthermore, the ground station and operation logistics were designed to allow the drone to fulfil its functions extremely cost-efficiently, requiring only 11% of GSs and 21% of UAVs as originally requested by stakeholders. A second set of detailed analyses were performed to optimise the design of the drone and to gather its characteristics of the fields mentioned before. In addition, a flight simulation program has been developed to validate the performance of the drone during flight. With the design finalised, a production plan was created to allow the drone to be manufactured and tested. The sustainability of the production and operations of the entire system was evaluated. The zero-emission propulsion system ensures a low carbon footprint. In fact, the total greenhouse gas emissions of production and operations are less than a single-seat flight from London to New York.