PhD THESIS ABSTRACT

“CONTRIBUTIONS TO THE DEVELOPMENT OF A UAV POWERED BY PHOTOVOLTAIC ENERGY”

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In the era of advanced technology, UAV systems are revolutionizing the field of aerial monitoring, providing exceptional capabilities for detailed land surveillance, natural disaster management, and precise execution of military missions, significantly contributing to national security and the efficiency of interventions in critical scenarios.

This paper addresses the challenges associated with powering UAVs using photovoltaic energy, exploring innovative strategies to extend the autonomy of this type of aerial platform. By analyzing the evolution of UAVs in this category, the thesis highlights significant progress in this field and its impact on the viability of flight missions.

The focus of this research lies in the development of a hybrid energy management system that integrates a photovoltaic system, a fuel cell, and a Li-Po battery. This innovative approach provides an efficient and flexible solution for various operating conditions, demonstrating redundant power resource management.

A key element of this study is the calculation algorithm, which optimizes the use of power sources to maximize the UAV's energy performance. Experimental tests have confirmed the system's ability to ensure efficient operation across a wide range of flight scenarios while adhering to quality standards applicable to the switching principles of energy sources.

The analysis of numerical modeling has provided a complete understanding of the energy system dynamics, emphasizing the importance of adaptability to power consumption. The implementation of the MPPT function and the development of a complex energy system have demonstrated efficient power consumption management in various operational scenarios.

Experimental tests have validated the hybrid power strategy, highlighting the efficiency of adapting the photovoltaic system to variations in light intensity and the essential role of the battery in critical flight phases.

Additionally, this work explored the potential of the electrostatic field in increasing the efficiency of photovoltaic cells, opening new directions for improving the performance of photovoltaic systems integrated on UAVs.

Thus, the results and personal contributions described in the thesis underline the success of implementing the hybrid energy system, demonstrating its viability in supporting long-duration aerial missions. This innovative energy system ensures increased autonomy and enhanced reliability, essential elements for extended and efficient operation of UAVs in various flight scenarios.