Abstract – EN

This doctoral thesis addresses the issue of limited endurance in multi-rotor unmanned aerial systems by investigating and comparing two complementary approaches: aerodynamic optimization through the integration of lifting wings and energy optimization via the implementation of a hybrid propulsion system equipped with a microturbine generator (MTG). The research proposes innovative solutions that combine the stability and versatility of a quadcopter with the energy efficiency of fixed-wing aircraft, aiming to develop UAV platforms with extended autonomy and improved performance for both civil and defense applications.

In the first research direction, a hybrid quadcopter with lifting wings was designed and experimentally tested, supported by CFD simulations and wind-tunnel measurements. The results revealed a reduction in energy consumption of over 30% and an increase in maximum flight speed by approximately 10%, achieved through the redistribution of lift between rotors and wings during forward flight. The second research direction focused on the development of a hybrid propulsion system based on a microturbine generator, capable of supplying real-time electrical power to the UAV's motors. Experimental tests on a dedicated stand demonstrated voltage stabilization and an increase in flight endurance by up to 125% compared to fully electric configurations.

The research methodology combines theoretical analysis, numerical simulations (CFD, Matlab), and laboratory experiments, validating the proposed hypotheses. The results confirm the feasibility of the proposed hybrid solutions and provide a solid foundation for the future development of long-endurance UAVs dedicated to monitoring, logistics, and scientific applications.