ABSTRACT

Unmanned Aerial Vehicles (UAV) have continued to evolve as effective solutions for various monitoring missions, including agriculture, conservation, and disaster mitigation. One of the main challenges lies in power efficiency, which directly determines flight range and operational endurance. This study focuses on optimizing the use of an airspeed sensor to improve energy efficiency in quadplane UAVs during fixed-wing flight. The quadplane configuration was selected because it combines the vertical take-off and landing (VTOL) capability with the aerodynamic efficiency of fixed wings.

The experiments were conducted to evaluate the importance of airspeed sensors in stabilizing throttle response and their impact on overall energy efficiency, particularly during cruising. Sensor validation was performed by comparing measured airspeed with theoretical values derived from Bernoulli's equation as well as with GPS-based ground speed. Performance tests were carried out in waypoint missions at a speed of 22 m/s and an altitude of ±300 m to analyze throttle stability, and in loiter missions at a speed of 16 m/s with an altitude and radius of ±300 m to assess energy efficiency.

The results showed that the airspeed sensor achieved an accuracy of ±98%. With the sensor enabled, throttle response was significantly more stable compared to when it was disabled, where large fluctuations occurred. The average power consumption during the energy efficiency test was 115.73 W with a total energy usage of 40.50 Wh. The achieved efficiency was 2.15 Wh/km, which is considerably better than that of conventional multirotor UAVs such as the Typhoon H480, which reached 8.80 Wh/km. These findings demonstrate that airspeed sensor integration enhances both control stability and energy efficiency in fixed-wing UAVs, supporting the development of energy-efficient UAVs for long-range monitoring missions that are more reliable, economical, and sustainable.

Keywords: *airspeed sensor, energy efficiency, fixed-wing, quadplane, UAV*