SkyLinker: UAV Autonomous Perpetual Solar Flight for Facilitation of Mobile Communication and Long-Distance Surveillance

Xu, Michael (School: Delbarton School)

Expanding the applications of Unmanned Aerial Vehicles (UAVs) requires overcoming limitations in flight endurance imposed by current battery energy densities and adverse weather conditions like wind and cloud cover. This research aims to address these challenges by developing a high-payload autonomous UAV powered by solar energy, enabling extended flights spanning multiple days and potentially perpetually. After undergoing eight iterative versions and enduring seven crashes, a compact 2.40m wingspan aircraft weighing 1.55kg and accommodating a 1.42kg payload was engineered with autonomous navigation and self-stabilization capabilities in crosswinds up to 37km/h. The eighteen 3.6W solar panels generated 29W of electricity, surpassing the 8.43W required for sustained flight at 43km/h. Flight testing at 40°N latitude in September demonstrated a promising 25% minimum state-of-charge, 4.5hr excess flight time, and 6.1hr charge margin during a 24-hour day/night cycle. These performance metrics represent a significant improvement from previous solar-powered UAVs. With improved capabilities, this aircraft can be applied to facilitate mobile communication by housing antennas within the aircraft, replacing the need for cost-prohibitive cell towers. Additionally, this solar-powered UAV's expanded flight endurance can revolutionize surveillance applications, such as monitoring solar and wind infrastructure, assessing crop health, and surveying disaster zones for a more effective response. This novel aircraft constructed from just $580 in materials showcases the growing feasibility of constructing cost-effective solar-powered UAVs using current solar technology. Furthermore, this research contributes one of the first open-source 3D models in order to accelerate future UAV research.