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Solar Powered Drones: New Trend

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In recent years, unmanned aerial vehicles (UAV) have seen an increase in their use in a variety of applications, including those used by the military and those utilised by the wider populace. In fields such as precision agriculture, remote sensing, environmental monitoring, and disaster relief operations, UAVs have proven to be extremely useful. They can now offer increased levels of security and convenience for tasks that previously required the presence of a human pilot. There is a natural tendency to make the systems more flexible and resilient in terms of their capabilities whenever there is a growth in the number of uses for the technology.[1] The concept of drones was only a dream not too long ago; today, however, technology has advanced to new heights, much like solar power has.

In September 2022, China successfully tested its first solar powered UAV. This UAV has the ability to remain in the air for months at a time and can even operate as a satellite if necessary. According to a tweet from a Chinese official, the *Qimingxing*-50 has successfully completed its first flight, making it the first large-sized UAV to be solely powered by solar energy.[2]

Using UAV as a Substitute for a Satellite

The Chinese UAV's name translates to 'Morning Star-50' in English. Due to its ability to maintain flight for an extended period of time, one of its potential applications is as a satellite. It can operate at a height of 20 km above the surface of the earth continuously for an extended period of time because, like satellites, it is completely electric-driven and powered by solar energy. In some circles, it is also known as a 'High Altitude Platform Stations,' while others call it a 'pseudo satellite.' It is possible to make use of it in situations where satellite services are either unavailable or disrupted.

In addition, according to the report, the overall cost of using this UAV is much lower. Its operation is much simpler than that of putting a satellite into orbit, which can be quite expensive and complicated.

Competing Nations

Both the United States and the United Kingdom have already developed solar-powered drones that are able to travel a distance of 20 km into the atmosphere. The United States Army participated in the testing of a solar-powered, near-space drone called Airbus Zephyr S in July 2022. The drone remained in the sky for 64 consecutive days before it crashed in Arizona.[3] At the beginning of 2019, a high-altitude pseudo-satellite called 'Hawk30' was created for the purpose of high-altitude communications. It was successful in completing its test flights. It is an upgraded version of the Pathfinder and Helios missions flown by NASA.[4]

Significance of Solar-Drones

In comparison to rotary-based UAVs, which produce lift by means of sets of blades, fixed-wing UAVs, which produce lift by means of a wing, are believed to have a greater capacity for endurance. In a fixed wing UAV, the majority of the power consumed goes towards fighting the drag, while the lift is produced by the flow that goes over the wings. As a result, in comparison to rotary-wing aircraft, fixed-wing aircraft are more fuel-efficient and have the capacity to transport a greater payload. Yet, due to the fixed energy stores that an aircraft takes with it in the form of battery packs and/or fuel, there's a limit to the amount of time that an aircraft may remain airborne. Because of this, the technology to harvest energy while the aeroplane is in motion is currently being developed. Solar energy as a source of propulsion for aeroplanes is quickly becoming one of the most viable options. It is possible for an aircraft to have a long-endurance capability, particularly in the extreme form of continuous flight over multiple days, sometimes known as perpetual endurance, if it has been carefully constructed and appropriate environmental conditions have been met.[5]

Following the inaugural flight of a solar-powered aircraft on November 4, 1974, we have come a long way. The most recent example of this is the attempt by Switzerland based Solar Impulse to fly around the world in an aircraft that has a wingspan of 72 metres and weighs 2,300 kg.[6] It has applications in the fields of aeronautical engineering, new materials research, and renewable sources of energy.

Therefore, despite the fact that a significant amount of progress has been made in the High-Altitude-Long-Endurance (HALE) class of solar-powered aircraft with large wingspans (above 20 metres), a significant amount of progress is still required in the Low-Altitude Long-Endurance (LALE) class. Notable attempts include the UAV developed by AC Propulsion, which flew continuously for 48 hours while looking for updrafts; the 3.2-meter-wingspan Sky-Sailor, which flew for 27 hours while using updrafts; and most recently, the Atlantik Solar, a UAV with a 5.6-meter-wingspan that was developed for search and rescue (SAR) operations.

Irradiance of the Sun

The effectiveness of a solar UAV that is heavily dependent on the degree to which the system is optimised to make use of the sun's rays. In this light, it was essential to study the solar radiance that is accessible at the site of operations. The solar constant, abbreviated as, is the amount of energy obtained from the sun on a unit area of the surface that is perpendicular to the direction of propagation of the radiation when measured at the mean distance between the earth and the sun, which is one astronomical unit (AU), and when there is no atmosphere present.

Solar Cells

Solar cells, also known as photovoltaic cells, are devices that use the photovoltaic effect to convert solar energy into electrical energy. Another name for solar cells is photovoltaic cells. Space applications make extensive use of solar panels because they provide a source of energy that is both clean and reliable for long periods of time and requires almost no maintenance. Solar cells can have anywhere from one to several layers, each of which is composed of a different semiconducting material. Silicon is the most common material used because it is the second most abundant element in the earth's crust, making it relatively inexpensive. Drone technology isn't limited to the study of how to attach solar panels to flying machines. Solar power is also being considered by businesses as a means of charging conventional drone fleets. US-based Envision Solar is one of the companies working on a charging product through solar.[7]

Advantages

Solar drones are UAVs that get their power from the sun rather than batteries. There are a number of benefits to using them.[8] A few of them are:

- *Economical*: By harnessing clean solar power instead of expensive grid electricity, solar-powered drones can cut down on the costs of drone-delivered missions.
- *Better Endurance*: The increased distance and time that solar-powered drones may spend in the air before needing to come home to recharge or refuel. For certain solar-powered drones, that means years in the air.
- *Weather Updates*: Hurricanes, bad weather, an impending storm, and tsunami warning tracking are all possible uses for solar-powered drones, which can soar far above ground level.
- *Disaster Relief*: Solar-powered UAVs can locate survivors, assess the damage, and access inaccessible locations.

Disadvantages

There are a number of issues associated with flying solar drones. A few are appended below:

- *Connectivity Issues*: Long-term drone flight presents a number of challenges, including the potential for the drone to lose connection with the controller.
- *Battery Life*: Solar drones can only fly when exposed to sufficient sunshine. Night time and overcast conditions may reduce their flying time or require them to use backup batteries.
- *Weight and Efficiency*: To achieve their full potential, solar-powered UAVs must be equipped with solar cells. These solar cells, however, may be heavy, expensive, or in short supply. Smaller batteries mean limited flight hours.
- *Space Constraints*: Most of the drones likely won't have enough room for solar panels and backup batteries. So it could have an effect on payload capacity as well as space management.

Indian Solar-Drone

MARAAL is a series of solar-powered UAVs that were developed in India by the aerospace department of IIT Kanpur. These are multipurpose UAVs primarily focused on defence requirements.[9]

Trial Details

Every single flight test was conducted on an airstrip that is a part of IIT Kanpur. During the subsequent flights, the autopilot was put through its paces, and its settings were fine-tuned in order to achieve the best possible performance in terms of path following and power consumption. The flight only took place during the day and involved a simulation of an earlier take-off. The pilot was

instructed to climb at a constant rate of 0.05 metres per second after the aircraft was given the command to take off at 0930 IST with nearly depleted batteries. It was determined that a velocity of 15 metres per second would provide the autopilot with the optimal amount of command input for low-power flight. The amount of power that was used by the system, the amount of power generated by the solar cells, and the status of the battery charging were all monitored. When the power being generated was less than the power required by the system, the throttle was cut off, and the pilot was given the instruction to glide the aircraft while maintaining a sink rate of 0.15 metres per second. During this time, the power that was generated was put to use by charging the batteries continuously. This was stopped at an altitude of 100 metres, where the aircraft was given instructions to slow the rate of descent while increasing the throttle in order to fully charge the batteries before landing. The aircraft made a safe landing at 1800 IST with a battery that was completely charged. It demonstrated an endurance of 8 hours and 30 minutes.

Present Status

There have been some exciting new developments in solar-powered drone technology in India recently. Garuda Aerospace, a start-up based in Chennai, has developed a solar-powered drone called 'SURAJ'. It is an ISR (intelligence, surveillance, reconnaissance) high-altitude drone created for surveillance operations, with the express purpose of providing real-time information to the high command and protecting jawans on the ground. It debuted at the Aero India 2023 convention in Bengaluru. It can carry 10 kg, fly at an altitude of 3,000 feet, and have a 12-hour flight time.[10] 'Infinity' is a solar-powered surveillance drone created by Hyderabad-based start-up New Space Research and Technologies in partnership with Hindustan Aeronautics Limited (HAL). It can stay in the air for up to 90 days at an altitude of 65,000 feet, where it can spy on enemies.[11] Nagpur based Solar Industries prepared solar-powered drones that are equipped to carry explosives and launch autonomous or remote attacks on targets. The Indian government asserts that these are the country's first entirely homegrown weaponised drones and loitering munitions.[12]

Conclusion

Solar-powered aircraft is a new product in the growing drone industry. Drones have many recreational uses, such as videography, aerial photography, and even drone racing, but they also have serious commercial and military applications. Commercial or military drones often struggle with range because of their inability to keep their batteries charged for extended periods of time. That's why scientists are investigating the feasibility of using solar energy to power flying drones and entire

drone fleets. The technology of solar drones will strengthen the defences of nations, both in outer space and at sea. The advancements in solar-powered drone technology in India are examples of the promising future of solar energy in defence and national security. A military commander can plan an offensive mission, respond to developing tactical threats, and choose effective countermeasures with the help of real-time ISR data provided by a solar powered drones. Indian development in the field of solar drones is heartening. Relevant research and development with consistent efforts and design changes may be introduced for enhancement of the widening exploitation. State-of-the-art solar demands will be able to contribute to op-preparedness.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])

Notes:

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[3] Ibid.

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