

High Altitude Platform Vehicle Redefines Aerial Surveillance



IN the realm of aerospace innovation, CSIR's National Aerospace Laboratories (NAL), based in Bengaluru, has unveiled a remarkable deep technology innovation known as the High Altitude Platform (HAP) vehicle. This groundbreaking creation, a solar-powered Unmanned Aerial Vehicle (UAV) beyond Visual Line of Sight operation capability, is poised to be a game-changer and serve as a pseudo satellite.

High-Altitude Pseudo Satellites (HAPS), when equipped with a payload, hold immense potential across a spectrum of civilian and military applications. From maritime and land surveillance to response to disasters, environmental monitoring, and border control, the versatility of HAPS transcends traditional boundaries. These aerial platforms also play a vital role in intelligent transportation systems,

“HAP vehicle has been completely indigenously designed and manufactured within CSIR-NAL, and I am looking forward to, and I am very confident that we will be able to prove all the capabilities and the design aspects for the 24-hour endurance going forward,” Dr Abhay A Pashilkar, Director of CSIR-NAL.

emergency communications, and restoration of communication networks, mitigating the risk of network failures. Moreover, they support Search and Rescue (SAR) activities, evidence collection, and early warning systems.

The development of the High Altitude Platform (HAP) vehicle by CSIR-NAL marks a significant milestone for India, positioning the nation among the top contenders in High Altitude Pseudo Satellite (HAPS) technology, following South Korea and the United Kingdom (UK). Operating at altitudes ranging from 18 to 20 kilometres, the HAP offers consistent aerial surveillance and monitoring capabilities, harnessing solar power for propulsion and operation.

Successful Flight Trials

In a recent breakthrough, scientists at CSIR-NAL conducted a series of successful flight trials for a sub-scale model of the HAPS, a lightweight, solar-powered Unmanned Aerial Vehicle (UAV). The 10-day testing period between 23 January and 2 February 2024 exceeded expectations. The prototype, boasting an impressive 12-metre wingspan yet weighing less than 22 kilograms, was put through its paces at the Defence Research and Development Organisation's Aeronautical Test Range (ATR) in Challakere, Karnataka. The trials meticulously replicated real-world conditions, including all necessary payloads and flight systems. The highly anticipated tests yielded impressive results, with the prototype surpassing performance benchmarks.

Dr Abhay A Pashilkar, Director of CSIR-NAL, elaborates on the distinctive features and challenges associated with the HAP vehicle: “The HAPS stands for High Altitude Platform System, and this is meant for persistent surveillance at about between 18 to 20 kilometres. This has both militaries as well as civilian applications, and the speciality of this particular vehicle is that it poses a great deal of challenges in all aspects of aeronautics, particularly aerodynamics. Very lightweight composite structures are required, and we also need to power them with solar power because they have to remain in the air for indefinitely as long as possible. This also means that during the night when there is no solar energy available, the vehicle has to essentially store the excess energy gathered during the daytime in very high energy density batteries.”

The recent test flight conducted by CSIR-NAL between 23 January and 2 February 2024, showcased the capabilities of a sub-scale version of the HAPS, a lightweight solar-powered UAV. Dr L Venkatakrishnan, Programme Director of High Altitude Platform at CSIR-NAL, sheds light on the significance

of HAPs in the aerospace landscape: “A high altitude platform is essentially an unmanned aerial vehicle stationed at an altitude of 20 kilometres above the Earth's surface (in the stratosphere) to form part of a telecommunication or earth observation network. This altitude is chosen to be above normal flight corridors and the weather.”

He further explains the unique advantages of HAPs over traditional satellites and UAVs: “HAPs combine the geographical persistence of a geostationary satellite with the flexibility of re-tasking and redeployment of an aircraft. This makes them unique in capability and fills an existing gap between aircraft and satellite.”

Despite their potential, HAPs also present formidable challenges. Ensuring sufficient solar power to sustain flight and charge batteries for nocturnal operations remains a critical concern. Additionally, the extreme temperatures in the stratosphere, plunging to minus 50 degrees Celsius, pose challenges in maintaining operational efficiency and battery performance.

Dr Pashilkar emphasises the complexity of managing energy resources during flight: “From a control perspective,

“The CSIR-NAL's HAP is a heavier than air aircraft with a wingspan almost that of a Boeing 737 but the weight of just a common motorcycle. This is because all the energy of flight and the payload must be generated just on its wing surface using solar photovoltaic cells during the day and stored in batteries on board to last the duration of the night. This calls for a grand challenge in an extremely energy-efficient design,” Dr L Venkatakrishnan, Programme Director of High Altitude Platform at CSIR-NAL.

this vehicle is particularly challenging because it requires us to manage the energy as the vehicle is flying. In pursuit of this, NAL has successfully built and test flown, accomplished in January 2024.”

The successful development and testing of the HAP vehicle represent a remarkable feat in aerospace engineering, underscoring India's prowess in cutting-edge technology and innovation. As CSIR-NAL continues to refine and enhance the capabilities of HAPs, the potential for revolutionising aerial surveillance, communication, and monitoring systems becomes increasingly tangible. With the ability to operate for extended durations at high altitudes powered by renewable energy sources, HAPs herald a new era in aerospace advancement, bridging the gap between conventional UAVs and satellites.

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