PATHFINDER
AIR POWER DEVELOPMENT CENTRE BULLETIN

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EXPLOITING THE NEAR-SPACE

The edge of space is difficult to define both legally and scientifically, but the Karman Line, at an altitude of 100 kilometres above Earth's mean sea level, is internationally recognised as the nominal boundary separating outer space from the Earth's atmosphere. It is also accepted as the boundary that separates aeronautics and astronautics. The term 'outer space' is not legally defined in international law. But it is widely accepted that a nation's sovereign airspace ends, and outer space begins, at some point between the lowest orbit altitude of artificial satellites or alternatively the highest altitude of conventional aerodynamic flight and the Karman Line. However, currently the International Civil Aviation Organisation (ICAO) controlled airspace is limited at 60,000 feet thereby leaving a big swath of airspace untended.

The altitudes between about 65,000 feet and 300,000 feet, where sovereignty of airspace itself is vague, has been termed the near-space realm and is characterised by the fact that the air is too thin for conventional aircraft to operate and gravitational pull and atmospheric drag are too high for satellite orbit. This part of the atmosphere has until recently been ignored.

About two years ago, military planners evinced interest in utilising this space for military applications, especially for deploying communications and surveillance assets. This has led to concerted research being carried out in reinvigorating mid-twentieth century technologies associated with airships. Airships can operate between 10,000 and 300,000 feet and can be divided into two variants – aerostats which are tethered and blimps which are free moving.

There are two compelling reasons for this renewed interest. Firstly, in the rarefied atmosphere that the platform has to operate in, a lighter-than-air structure would be easier to manoeuvre and the lightness would require only limited power to propel it. The airships are also free of the vibration experienced in a rigid aircraft, and therefore simply provide a safe and stable operating environment for highly sensitive equipment and sensors. Second, airships are comparatively inexpensive to manufacture, maintain and operate and can stay afloat indefinitely if they are uninhabited. Even when they are crewed, they can be airborne for a long period of time, sufficient to have a real persistence.

The airship is being conceptually looked at for three major roles in the future – persistent surveillance, strategic airlift and missile early warning as well as the bonus of it being a communications relay node.

A-170 Airship being prepared for flight

Developments in the design of airships are oriented towards allowing them to stay over a designated area for months on end to provide persistent surveillance of sufficient fidelity to let commanders make informed decisions. Persistent surveillance and near real-time availability of this information to the decision makers is a much sought after capability in modern military forces. The fixed-wing platforms or satellites currently operational do not provide the uninterrupted surveillance required for the long durations that are demanded by contemporary military forces. It is expected that the near-space airships will ameliorate this particular drawback.

It has been observed that, if used at the lower fringes of near-space, airships could be employed as large strategic airlift platforms that could provide swift transportation of a very high quantity of personnel and equipment – much more than the largest airlift capability currently available from aircraft. Strategic airlift by airships is planned to be achieved by a combination of airship and pure aerodynamic characteristics in the same vehicle. These platforms will be heavier-than-air and will use conventional power and aerodynamics to take off and land, albeit at very slow speeds. The ships would be capable of transporting up to 1,500 tonne payloads (an entire army brigade with its organic equipment) at a speed of 120 kts within a radius of 6,000 kms with

an on-station loiter of more than 10 hours. However, operational problems, such as the hazard posed by a combination of low altitude of transit, slow speed and the survivability of a helium-filled platform have so far slowed developmental work.

The latest development has been of cheap, disposable aerostats that are tethered at a lower altitude (around 100,000 feet) than airships. These can be deployed from the back of a Humvee and are designed to float within a predictable pre-determined pattern for as long as 12 hours. Once matured, the aerostats are expected to become a viable early warning device in the larger missile defence system. They can also be used as communications hubs and increase the range of a hand-held radio from the current maximum of 16 km to more than 800 km.

Aerostat developed by Lockheed Martin for deployment in Iraq

Although proponents of airships have earnestly advanced the above advantages, there are a number of technological difficulties that have yet to be addressed before the concept can be transformed into reality. Uninhabited airships tend to stray away from their designated area of surveillance and are not as survivable as aircraft in rough weather. There are also doubts regarding the runway length requirement of airships being used in the airlift role. The high operating altitude requires light-weight fabrics that can withstand the increased intensity of ultra-violet sunlight, which is one of the major issues being addressed by researchers. There is also uncertainty regarding the atmospheric conditions at the near-space operating altitudes in terms of wind velocity and the power required to be produced by a propulsion system to manoeuvre the airship against high wind velocities.

Current research is oriented towards solving the issue of fabric toughness, tapping solar energy to ensure an uninterrupted energy source for a very long period and improving the fidelity and power of electronic sensors while reducing their size. As in most other regimes of aerospace research, the United States have the most promising on-going programs and are likely to be the first to field any operational capability, maybe within the next decade or so.

Despite the problems being encountered in the design and development of airships, the tangible advantages that can be derived from an operational airship deployed in near-space should encourage further research and development in the area. The most obvious advantage is that it provides a low-cost alternative to nations that do not have a dedicated space program to support defence needs.

Although the airship technology can be considered to be in its infancy, considering that the developments of the mid-twentieth century were minimal, the advantages that high altitude, long endurance airships bring to the conduct of military operations in terms of clearly enhanced situational awareness points to the need for any forward thinking air force to investigate and research the possibilities and to develop advanced concepts for their employment.

- *Near-space is not currently utilised to enhance military operational capabilities.*
- *Airships operating above 100,000 feet could provide a cost-effective alternative to persistent long-term surveillance, strategic airlift, missile early warning and act as communications relay nodes.*
- *The technology is still in its infancy but needs to be developed further.*

The bias toward the offensive creates special problems in any technologically new situation where there is little or no relevant war experience to help one reach a balanced judgement.

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