Data Transmission Techniques in High Altitude Platforms and Via High Altitude Platforms

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Abstract:

Now a days different techniques for wireless transmission for communications, multimedia services play a Vital role in the development of mankind, in this seedy and needy days. Global development depends on the communication system between the countries that is global communications. This paper provides the information about techniques of communication systems or services or processes in Haps. Not only for communications these are very useful to other fields like oil spill detection and remote sensing and solar power generation in space. The Haps are the space based air ships, or aircrafts and the platforms at an altitude from 20km to 50km, ie above 80,000feet, in stratosphere, called specially as stratospheric platforms used for wireless communications, multimedia communications. These are the best solutions nowadays when compare with satellites and terrestrial systems. These are cheaper than satellite and terrestrial systems. The Haps need 1/10 of a satellite infrastructure, but 1000times of satellite coverage, but closer to terrestrial. These need less launch cost than satellite and terrestrial networks. Haps will offer cheaper solutions, medium density areas filling the gap between cables/fibre for high density cities and satellite for sparsely populated areas. This gives brief picture about the techniques, can be useful to scholars who want to work on these high altitude platforms and their networks. It covers low cast broadband techniques aimed at providing ubiquitous coverage to users marginalized by geography, distance from
infrastructure or those travelling inside high speed public transport vehicles and aero planes.

1. Introduction
Haps for communications and remote sensing were discussed. Remote sensing is studied by air borne or space borne systems. Space born systems offer a very stable platform and allow global coverage but restrict for satellite communications during the cloud cover they cannot be monitor or recording. This problem will overcome by high altitude platforms. When there are compared it with air born, the air born have less scope when compare it to space born, even thou they are capable to produce high resolution data with great flexibility and response times. These are very expensive and are not stable and driving along the desired path lines very difficult.

Here the (Fransaer et al. 2004) is the best example for this. The system will deliver data and information. That is directly usable for GMES (Global Monitoring for Environment and Security). Applications as well as for medium and small scale mapping applications. The combination of its sensors gives it an all weather, 24 hours observing is critical which is in

PEGASUS is the acronym for the “policy support for European Government by Acquisition of information satellite and UAV borne sensors”) is project is aim to provide a low cost and easy way to gather high resolution data (visual, IR and thermal imagery, bLIDAR, SAR atmosphere measurements) from high altitude platform. Under this project design of both platform and instruments, were studied. Under this project merits of certain properties like, optical design, weight considerations, power consumption, data transmission, processing and archiving. This design overcome certain requirements of many remote sensing applications.

2. Long Endurance Stratospheric UAV
2.1 Unmanned Aerial Vehicle
The military is to help the people under “dirty, dusty, dull and dangerous environments”. Uavs are widely used in these applications. The Helios prototype and the Global Hawk, have Wings spans up to 75 m. The helios has an world record of flying to 96,863 ft in august 2001 powered by solar cells. Solar energy is the only excellent source of fuel to UAVS to avoid its heavy size. Nuclear power also play a vital role with limitations with risk of mishap.

Most high altitude UAV system are aero dynamic, generating lift by moving. The total lift force is determined by the crafts speed, its wing area, and the density of the surrounding air. The large uavs like helios with 930 kg weight and wing span of 75 m exceeding that of Boeing 747. These are very expensive excluding the difficulties in finding run ways and hangars. Therefore we favor using small UAVS wing spans of 15 to 20 m, that carry small payloads (2 to 5 kg), excluding batteries, electronics.
2.2 Review of literature
Aero static systems for high altitude flight have been proposed, but are not operational. They need large volumes of helium and controlling such large volumes steering them require large amount of power to be provided by solar cells draped over the envelope of the blimp. These are more expensive than aero dynamic systems.

2.3 Stratospheric Environment
The stratosphere is characterized by an almost complete lack of water vapor, relatively low winds speeds (10m/s on average), only limited turbulence and low temperatures (-50 to -70°C).

![Figure 1: Average and maximum wind speeds for the years 2002-2003 for elevations up to 30 km (data for Den Helder, Netherlands, March-September)](image)

3. Solar Energy:
At high altitude the solar irradince is high than at low altitudes. That is 1,368 w/m2 of energy provided by solar radiation. In order to continuous usage, the uav needs at least 2500 wh/m2/day, which is available for 7 months (March-September) at season of
7 months, taking cloud cover into account. Unlike manned it can the advantage of taking a small window in the cloud cover. At a modest speed of 20 m/s, the platform can be transferred over large distances (over 1700 km) in 24 hours, even if there are no favourable winds.

4. Design Philosophy:
The design of the remote sensing instruments and the auxiliary systems are weight, power consumption, and volume. At this stage of the project, the UAV cannot carry payloads heavier than 2 kg, unless it is scaled up. The power available for the payload is of the order of 1 KW, the remaining electrical power generated by the solar cells being used for the flight systems itself. The volume constraint is probably the most difficult one to deal with; the instruments should be designed to fit within the limited volume and irregular shape of the aircraft's fuselage. In a few years, it will emerge as a new trend or technique being able to carry heavier payloads and provide more power.

5. Pay Loads
The important payloads are (1) Multispectral Digital Camera (2) Lidar (3) thermal Digital camera (4) SAR (5) atmospheric measurements.

5.1 Multi Digital Camera:
The Multi digital camera is used in this UAV to use heat months (March-September) at the thermal digital camera will operate in two thermal infrared bands (SWIR): 3-5 µm and LWIR: 8-12 µm (depending) with spatial resolution between 1.1 and 2.2 m (depending on the wavelength).

5.2.1 Types of Digital Cams in Sensors:
Three alternatives are available: ternary semiconductors such as Hg₅Cd₁₋ₓTe (also referred to as MCT, Mercury Cadmium Telluride), where the spectral sensitivity is determined by the value of x, multilayer structures or QWIP (Quantum Well Infrared Photo detector) sensors, where the spectral sensitivity is determined by the thickness of the successive layers, and microbolometer that work by heating from absorption of IR radiation. The former two require cooling (to 77 K), the latter can work uncooled. However, large optics (f/1) are required for microbolometer, so they cannot be considered further in this project. Typical sensor pixel sizes are 25 µm for SWIR and 50 µm for LWIR. For a refractive instrument, ZnSe can be used as optical material, covering the 3–12 µm spectral range. In the Design of this, the aperture thermal camera is chosen to be the same as for the multispectral camera: 0.13 m. Using a 0.44 m focal length, this will have a 1.13 m resolution in SWIR and 2.25 m in LWIR. To cover the same swath as the multispectral camera, the SWIR sensor will be a line array of 1 600 pixels, and the LWIR sensor will have an 800 pixels wide line.
5.2.2 SAR: The Synthetic Aperture Radar adds an all weather, day-and-night capability to the sensors suite. Aimed at environmental and security applications (oil spills, flooding, …), it will operate at short wavelength (X-band).

5.2.3 Atmospheric measurements: The instruments in UAV PAYLOAD can provide in situ measurements of the stratospheric environment, such as temperature and the detection of chemical compounds such as water vapor, ozone, carbon monoxide, carbon dioxide, methane or nitrogen oxides, many of which are linked to global warning issues.

6. Ground Segment:
The ground segment contains (.1) Mission planning and execution. (2) Reception (3) Data processing: and future scope of work.[1]

7. Helinet Project for Broad band Communications and Cellular Communication:
Here modeling cellular architectures were discussed. Here hap-based cellular networks were discussed and their differences over terrestrial networks. For terrestrial networks were limited by interference. The interference is due to terrain and building will lead different values of interferences from place to place.

But hap-based system is prominently through fire space, with all cells being served from a common point. This will also limited by interference. But the level of interference may quietly less than for terrestrial Networks.

These old scenario here is the simplest approaches is to assume circularly symmetric beams and identical antennas illumination each cell with constant angular separation. Instead if we used a new approach, bin which hexagonal cell structure on the ground and select the antenna, properties to illuminate the cell in optimum way. Here an elliptic beams to give a circular foot print on the ground, the directivity is chosen to illuminate the cell edges with maximum power, the approaches similar approach is chosen for satellites of antenna.

In satellite antennas where the aperture size may be chosen to maximize the link budget at the edge of the geographical coverage area. Here in this scenario, neither the angular spacing of the antennas nor their directivity constant, and it must be calculated for each cell. The coverage is expressed in terms of carrier to interference ratio(IIR) has been found to be better than for constant angular spacing. The CIR is calculated is

\[ CIR = \frac{P_{MAX}}{\sum P_{OTHER}} \]  

Where p max is the Maximum power from the cell of interest and the \( p_{other} \) are the interfering powers from the other co-channel antennas. Data arrays of the form \{x,y,CIR\} are generated for each channel, where \{x,y\} Are the ground co-ordinates
depending on the chosen resolution, data arrays sizes are typically 10,000 elements for each of the co-channel antenna beams.

**Figure 2** Channel reuse schemes: (a) 4 channels; (b) 7 channels.

**Figure 3**: layout of hexagonal cells that from the ground to around 30 degrees.

**Figure 4**: Helinet.

The number of cells may be varied, but the payload in the range of 120. The software tools developed to provide considerable insight into the interference mechanism inherent in a HAP-BASED. A HAP at 17 km height serves a ground area of 60 km diameter so as to limit the elevation angle of the HAP from the ground to around 30. That from the concentric “rings” the 60 km diameter circle is also shown. Two examples of channels reuse scheme are shown by color coding. Although other channel reuse schemes have also been studied. In the reference paper 4 channel and 7 channels were illustrated and studied. For HAPs we are considering use of the 47/48 GHz band allocated by the ITU for HAP services, and/or the 28 GHz band. We are also assuming that data rates of at least 2 Mbit/s should be available to the customer. These millimeter-wave bands lead to a requirement for a line-of-sight link between the customer and the base-station, which for a terrestrial system leads to a large number of base-stations with their associated environ-mental and economic constraints. The HAP
broadband network discussed in this paper is a possible solution to these constraints. High-altitude platforms based on lighter-than-air vehicles

8. Conclusion
This project will become basic model for Remote sensing, using haps. Developing higher models Can be possible if any body interested in these regard. As these unmanned flights have advantages than with both airborne and space borne systems, with out their disadvantage. But the limited pay load or less can be overcome . This paper can give scope to analyze the possibilities of design high altitude platforms for broad communications and remote sensing collectively . This can useful to work on the communication pay loads along with remote sensing payloads. Two different techniques were discussed.

References


