Stratospheric Platforms: a Novel Technological Support for Earth Observation and Remote Sensing Applications

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ABSTRACT

The international community agrees that the new technology based on the use of Unmanned Air Vehicles High Altitude Very long Endurance (UAV-HAVE) could play an important role for the development of remote sensing and telecommunication applications. A UAV-HAVE vehicle can be described as a low-cost flying infrastructure (compared with satellites) optimized for long endurance operations at an altitude of about 20 km. Due to such features, its role is similar to satellites, with the major advantages of being less expensive, more flexible, movable on demand, and suitable for a larger class of applications.

According to this background, Politecnico di Torino is involved as coordinator in an important project named HeliNet, that represent one of the main activities in Europe in the field of stratospheric platforms, and is concerned with the development of a network of UAV-HAVE aircraft. A key point of this project is the feasibility study for the provision of several services, namely traffic monitoring, environmental surveillance, broadband communications and navigation.

This paper reports preliminary results on the HeliNet imaging system and its remote sensing applications. In fact, many environmental surveillance services (e.g. regional public services for agriculture, hydrology, fire protection, and more) require very high-resolution imaging, and can be offered at a lower cost if operated by a shared platform. The philosophy behind the HeliNet project seems to be particularly suitable to manage such missions. In particular, we present a system-level study of possible imaging payloads to be mounted on-board of a stratospheric platform to collect Earth observation data. Firstly, we address optical payloads such as multispectral and/or hyperspectral ones, which are a very short-term objective of the project. Secondly, as an example of mid-term on-board payload, we examine the possibility to carry on the platform a light-SAR system. For both types of payload, we show how intelligent processing algorithms for environmental data can be run on-board in real-time, in order to make data analysis and transmission more effective, and designed to match the constrains imposed by a UAV-HAVE platform. The results of the study lead to the conclusion that the stratospheric technology seems to be a competitive infrastructure (with respect to the satellites) in the remote sensing scenarios described above.

Keywords: High Altitude Platforms, optical Earth imaging, UAV payloads

1. INTRODUCTION

The project “HELINET - Network of stratospheric platforms for traffic monitoring, environmental surveillance and broadband services” has been funded by the European Commission within the Fifth Framework Programme of R&D (see1) (IST-1999-11214). The project is coordinated by Politecnico di Torino, and carried on by a consortium of ten industrial and academic partners from all over Europe. The project is concerned with the development HAVE-UAVs for civil applications; the main objectives are:

- to design a network of unmanned, solar powered aerodynamic stratospheric platforms with a payload of about 150 kg, an available power of 800 W, flying at a height of about 17 km, and to manufacture a platform scaled size prototype for static tests;5,6

- to develop payloads for integrated applications of such platforms.

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A network of stratospheric platforms could provide a cost-effective, sustainable and environmental-friendly framework for the provision of services; in this first phase, the following applications are being dealt with:

- Environmental surveillance: the platform will provide both data transponding from sensors to control centers and optical surveillance (e.g. fire/flood prevention, fast alarm, and so forth).
- Localisation services, based on GPS/Galileo and on Direction of Arrival (DOA) estimation. A feasibility study of the integration of such platforms within the Galileo system is currently being performed, and some preliminary results have been obtained.
- Feasibility study on the provision of telecommunication broadband services from the HeliNet platforms.

In all of these cases the project will end up with the definition of a prototype payload.

2. STRATOSPHERIC PLATFORMS FOR REMOTE SENSING APPLICATIONS

Many environmental surveillance missions involve very high resolution imaging, regional public services for agriculture, hydrology, fire protection, flooding prevention, traffic monitoring and disaster relief support, pollution monitoring and meteorological measurement, real time monitoring of seismic or coastal regions and terrestrial structures, and more. The philosophy behind the stratospheric platform projects seems to be particularly suitable to manage such missions. In fact, these platforms can be used to collect data from an on-board optical payload, with proper motion and vibration compensation, or from any other kind of sensor working in a different portion of the electromagnetic spectrum. These images are then processed by intelligent algorithms for on-board processing of environmental data, especially tailored to cope with problems involved in applications such as those cited above and designed to match the constraint that an unmanned solar powered platform can set. Moreover, this can be particularly exploited in emergency situations, by simply moving the platform in the region under emergence. In addition, the drastic shorter distance between the sensor and the Earth, in relation to satellites (about 20 km compared with 100-300 km for Low Orbit Satellites), opens interesting opportunities for applications requiring passive systems with extremely high resolution or active systems with low power consumption. As example, right now military technology is making available high resolution sensors (SAR and optical/infrared) for civil use. Accordingly, the recent scientific literature presents a huge number of processing techniques for data analysis and image exploitation. Based on previous works, such techniques must be modified and trimmed to tailor the specific application at hand as for the requirements imposed by the platform characteristics. This implies to devise novel algorithms able to select images containing objects of interest for each application, so making possible the design of systems where images can be demanded by a human operator, or automatically transmitted by the HeliNet processor to a control centre in case of possible automatic detection of phenomena or accidents.

3. OPTICAL PAYLOAD

In this section we present the rationale of the HeliNet on-board optical payload, as well as some information on the intended image processing applications.

3.1. General remarks

In the last decades, governmental and private organization increased their demand of Earth observation data defining a new research and commercial trend. This is also witnessed by the 2001 work programme of the Energy, environment and sustainable development thematic area under the Fifth Framework Programme of the European Union, which explicitly addresses the enhancement of existing remote sensing systems, as well the development of new ones, under Key Action "Research and technological development activities of a generic nature", Line 7.2 "Development of generic Earth observation technologies". This growing interest in remote sensing data has been boosted by the the recent availability of electro-optical and Synthetic Aperture Radar (SAR) images at very fine resolution. As an example, newly deployed satellites such as IKONOS are able to capture data from a 680 km polar sun synchronous orbit, yielding radiometrically and system-corrected images with resolution down to one meter, and covering most of the globe every 1.5-3 days. Such sharp one meter imagery allows to distinguish amazingly small objects (even to guess the lines of a football court!), thus enabling a wide range of new applications, or making the results of existing applications remarkably more accurate: 0.1-0.5 meter images are the next goal. For this reasons, it is a general belief
of the economists that the global sales of satellite images will be worth 2.5 billion dollars by 2005 (estimate by Merrill Lynch), i.e. sixteen times larger than today; a figure which is already achieved by the sales of aerial photography. The allurement of this market justifies the investments of private organisations, which are now complementing national and international space agencies as developers and commercial operators of these spaceborne systems.

Where do stratospheric platforms come into play? It is a known drawback of optical satellite systems, that their nominal revisit time of a few days (actually often protracted by bad weather) does not allow sufficiently timely Earth monitoring, for those applications where promptness of action is most critical, e.g. fire monitoring and disaster prevention. On the other hand, the all-weather capability of SAR systems is often outweighed by their grainy appearance and the unavailability of spectral selectivity, which is crucial in some applications. In such scenarios, local rather than global observations are called for; as a consequence, several companies are beginning to offer local aerial observations by means of low-altitude aircraft. This kind of service is very flexible, as such aircraft can be equipped with both optical and SAR sensors, and can be moved where needed. Their main disadvantage lies in the mission endurance, which usually does not exceed 4-5 hours, and is limited by the aircraft power supply system.

Stratospheric platforms act as a complement to satellite-based systems, and overcome the drawbacks of low-altitude aircraft. Since they fly at high altitude, but still much lower than satellites, their type of observation is local in nature. However, the concept of solar-powered aircraft allows the platforms to stay aloft for very long periods, thus enabling continuous monitoring of a region of interest, pictures being taken as soon as clear sky is on deck. A remarkable difference between stratospheric platforms, and satellites and low-altitude aircraft, lies in the cruise speed: in particular, stratospheric platforms fly at much lower speeds, so allowing to collect very redundant information of a scene. Since redundant information can be used to improve image resolution, it turns out that stratospheric platforms are able to achieve the same resolution as state-of-the-art satellite systems, but using commercial off-the-shelf imaging equipment, or to achieve much better resolution with the same kind of equipment. As an example, the demonstrator of the HeliNet optical payload will consist of a professional video camera operating at television frame rates, and is intended to achieve a resolution of 2 meters by enhancing the native sensor resolution by a factor of four in both the horizontal and vertical directions. This will permit to carry out with very good accuracy applications such as texture-based local agricultural monitoring.

3.2. On-board processing

The HeliNet optical payload invokes the concept on “on-board processing” in order to optimize system operation. On-board processing has been proposed so as to decentralize system intelligence directly on the remote platform. It is foreseen that future image analysis applications will be able to run directly on the on-board HeliNet processing system according to this paradigm, e.g. detection of forest fires or disaster prevention. Within the current phase of the project, a demonstration image analysis task is being developed, namely cloud detection. This application has been selected because it makes possible to save energy, by simply turning off the transmission system while clear sky is not present.

3.3. Image resolution enhancement

It is known that, under certain conditions, multiple views of a given region can be used to generate a higher resolution image of that region. These conditions involve that such views exhibit subpixel displacements, and that these displacements are known, or can be accurately estimated. This is the case of an aerial video camera carried on-board of a HeliNet platform. Due to the low platform speed with respect to ground, the payload can easily collect overlapping frames by operating a video camera at television frame rates. At the ground station, suitable algorithms can be used to exploit the redundant information of the overlapping frames in order to enhance ground resolution.

Besides being numerically ill-posed, image resolution enhancement algorithms are often computationally intensive. Ill-posedness implies that some assumption on the smoothness of the higher resolution image must be made (e.g. smoothness or piecewise smoothness), so as to regularize the restoration problem. In order to carry out the superresolution task for an $N \times N$ image, many algorithms require the inversion of a (sparse) $N^2 \times N^2$ matrix, which requires huge memory and computational resources. A trade-off is being evaluated between optimal algorithms with a unique solution (e.g. maximum likelihood), and other techniques such as projection onto convex sets (see e.g. 


4. ON BOARD PROCESSING ALGORITHMS

As stated previously, the HeliNet payload is defined taking into account the concept of "on-board data processing". Under this constraint, a general monitoring system can be designed in order to localize and identify Objects of Interest (OOIs) on the ground. Such a feature can be exploited, for example, in traffic monitoring systems, to track vehicles that do not want to show their position as mobiles that are hiding themselves to security forces. As an example, the solution adopted nowadays by the coast-guard for the monitoring of coasts is the use of aircrafts with a payload able to recognize and to track everything considered interested (usually everything but the sea). These reasons suggest that the use of HeliNet as a monitoring system could offer several advantages; more in detail, it is a flexible system movable on demand, operative 24 hours per day and with a quite large coverage area, due to its operative altitude of about 20 km.

In this section, as an example of application of the reconnaissance system, the possibility to survey the sea surface or coast tracts by means of high resolution SAR (Synthetic Aperture Radar) images is presented. To perform this task the platform must be equipped with a light SAR in order to meet the platform weight constrains. The employed strategy essentially consists of detection of OOIs over a background with texture features (as in case of sea, forests, agricultural regions).

In order to limit the data transmission to the ground control station, the whole SAR image content is digitally processed on-board with the purpose to select the images containing some OOI in order to transmit only these ones to the ground station, with a specific indication of the location of each OOI (as in case of). Such data are then transmitted through the downlink to the ground control station. Notice that this last point corresponds (de facto) to a process of extremely high data compression: in fact the bit rate in the down link could be completely devoted to the transmission of the OOIs, once they are detected.

A novel digital image processing algorithm, called OBI-FINDER (Object of Interest-Finder), based on the recognition of textures in SAR images, has been developed and implemented in order to recognize OOIs in the textured environment. Application of the presented algorithm to different environments with texture features is obtained simply changing some thresholding values.

It must be noticed that, in general, the problem of OOI detection in a still image containing OOIs over an non-interested background is generally a complicated problem, heavily depending on the specific application. If the problem must be solved with a robust and fast algorithm, a convenient choice is to exploit (if possible) some common characteristics of the images typically involved in the application at hand. In our context the idea was to design a sea-oriented method, by characterizing (if possible) the sea surface by means of some proper texture parameters.
This paper describes the study performed to reach this objective. The first step has been the representation of the sea surface as a texture. The main problem faced in pursuing such a task, is that a single sea image may exhibit different textures in different parts of the same image. Therefore a texture analysis can be used for the sea surface, but with methods able to deal with variable textures.

4.1. Sea Texture Analysis

In the considered application an OOI is any object emerging from a noisy or textured background and it is described as a close set of correlated samples. As usual, a digital image is represented as a matrix $A$ of $K \times L$ pixels; to each pixel a position $(k,l)$ and a quantized gray level $g(k,l)$ are associated.

The central point of the method is the possibility of identifying the sea surface as a texture (that represents the background in SAR images). As no formal definition of texture exists, intuitively it could be considered as a measure of properties such as smoothness, coarseness, and regularity. In the case of our purpose, it is introduced the concept of narrow texture, when a small group of close pixels exhibits a high luminance mean and a high variance, and of large texture, when both the luminance mean and the variance are low. These two definitions are introduced to properly describe the sea textures. In fact, from the analysis of several SAR images of the sea surface, it has been found that they exhibit both large and narrow textures in different parts of a single acquired image (as represented in Fig. 2).

The OOs are assumed to exhibit features that contrast clearly with the background. This is an evident postulate, as only OOs able to be distinguished can be detected. In particular OOs with high luminance and low variance are considered. This hypothesis is verified in most cases (as in the case of Fig. 2). For objects with different attributes simple variations of the method can be adopted.

5. OBI-FINDER DESCRIPTION

The OBI-FINDER algorithm is mainly based on the variance $\sigma^2_{k,l}$ associated to each pixel $(k,l)$. The variance is defined taking into account the gray levels of the neighbor pixels, that is the ones contained in a cell $W_{k,l}$ around the pixel $(k,l)$. In our application, the adopted definition is

$$\sigma^2_{k,l} = \sum_{i \in I_W} (g(k,l) - g(i))^2$$

where $I_W$ is a set representing the pixel locations inside the cell $W_{k,l}$, and $g(i)$ is the corresponding gray level.

This parameter can not be directly used for distinguishing an OOI from the background. In fact a high variance occurs in two cases:
Figure 3. Matrix $A_\sigma$ of the SAR image

1. when the cell does not contain an object, but it exhibits a narrow texture;
2. when the central pixel is on the OOI border.

Therefore it is evident that it is not possible to process the original image, on the basis of the variance, to extract the OOs from the background.

To perform this task a method has been designed, able to transform the matrix $A$ into a binary matrix $A_b$, containing white pixels at the OOI locations and black pixels at the background locations. The method is based on both the pixel variance and the luminance characteristics of the uniform regions of the image. Hereafter the sequence of the steps that provides the binary image is described.

1. The image is scanned pixel-by-pixel and the variance $\sigma_{b,l}^2$, as defined in (1), is evaluated for each pixel. A new matrix $A_\sigma$ is then constructed containing the parameter $\sigma_{b,l}$ (as represented in Fig. 3).
2. The matrix $A_\sigma$ is transformed into a binary matrix with a threshold mechanism, so obtaining a matrix $A_{\sigma b}$, with elements equal to 1 for high variance, and 0 for low variance.
3. The matrices $A$ and $A_{\sigma b}$ are compared and a new matrix $A_u$ is created. The pixel value of the new matrix coincides with the pixel value of the original matrix $A$, only at the locations where the binary matrix $A_{\sigma b}$ is equal to zero. Otherwise the pixel becomes a black pixel. The matrix $A_u$ will contain only the regions with low variance (an OOI without its border, and the uniform region of the background).
4. Due to the high luminance of the OOs, a threshold mechanism can be now applied to extract the OOs from the matrix $A_u$. In practice a binary matrix $A_b$ is created (Fig. 4), and a simple algorithm can now be designed to locate the OOs.

The main problem of this method is its complexity, due to the dimension of the matrices to be evaluated at each step. To reduce the complexity burden a preprocessing scheme able to isolate some regions, called in the following Regions Of Interest (ROIs) has been implemented. The activity of the OBI-FINDER algorithm will be concentrated only in the ROIs in a second stage of the complete detection algorithm.
Figure 4. Matrix $A_i$ of the SAR image

5.1. Pre-processing method

The main idea behind the pre-processing method here proposed is that of splitting the image $A$ in $N_w$ windows (subimages) $W_i, i = 1, \ldots, N_w$, each one containing $P$ pixels, whose position is represented by an index matrix $I_W$. For each window the mean gray level, defined as

$$\mu_i = E[g_i] = \frac{1}{P} \sum_{k,l \in I_w} g_{i+k, i+l}$$

(2)

and the root mean square, defined as

$$\sigma_i = \sqrt{\frac{1}{P} \sum_{k,l \in I_w} (g_{i+k, i+l} - E[g_i])^2}$$

(3)

are evaluated.

Notice that the two parameters $\sigma_i$ and $\mu_i$ depend on the global statistical properties of the pixels in the windows $W_i$, hence they can be considered as direction-independent parameters. This aspect is consistent with the considered detection problem, which is independent of the texture orientation.

The general scheme of the pre-processing algorithm is composed of three steps.

1. The original image $A$ is split in $L_W \times L_W$ windows $W_i$, the parameters $\mu_i$ and $\sigma_i$ are evaluated for each window, and two matrices $M$ (containing $\mu_i$) and $S$ (containing $\sigma_i$) are created. The size of both matrices is $K/L_W \times L/L_W$.

2. Two global parameters are evaluated related to the whole image, that is the global mean $\mu$ and the global variance $\sigma^2$. On the basis of these two values two threshold levels $\lambda_\mu$ and $\lambda_\sigma$ are introduced, each one related to the global mean and variance. For example $\lambda_\mu = \alpha_1 \mu$, and $\lambda_\sigma = \alpha_1 \sigma$, where $\alpha_1$ and $\alpha_2$ are coefficient to be chosen on the basis of some experimental results.

3. The presence of a ROI is detected by properly comparing the window statistical parameters with the threshold levels $\lambda_\mu$ and $\lambda_\sigma$. The comparison strategy is the relevant part of the algorithm and it will be explained in the next sections. In section 5.2 the case of a mono-modal large texture is considered, while section 5.3 deals with the case of a mono-modal narrow texture. These two cases are of interest only when the type of texture (large or narrow) is a priori known. In practical applications only the bi-modal hypothesis is correct. Section 5.4 presents how to combine the two previous methods to take into account the bi-modal assumption.
5.2. ROI detection in presence of large textures

If the image background is not bi-modal (or is scarcely bi-modal) and a large texture is predominant, a cell inside an OOI will exhibit a value of $\mu_i \gg \lambda_\mu$. Therefore a test based on this comparison is able to perform the detection of cells belonging to an OOI. On the other hand a test based on the variance is not significant, being the variance of both the OOIs and of the large-textured windows very small. Only the cells on the OOIs boundaries will exhibit high variance, and a test based on the rule $\sigma_i > \lambda_\sigma$ could be used as edge detector.

Therefore the complete test will be obtained by combining the two previous ones. In particular a cell $W_i$ is identified as belonging to a ROI if the union of the two events $[ (\mu_i > \lambda_\mu) \cup (\sigma_i > \lambda_\sigma) ]$ occurs.

The complexity of the preprocessing phase depends on the dimension of the windows $W_i$. Several experiments have shown that a proper value for the cell dimension is $L_w = 10$. This reduces the number of pixels for the ROI detection of a factor 100, with respect to the case of OOI detection based on OBI-FINDER.

5.3. ROI detection in presence of narrow textures

If the image background is not bi-modal (or it is scarcely bi-modal) and a narrow texture is predominant, a low contrast among OOIs and the background is experienced. The mean value of a cell inside an OOI $\mu_i$ is not greater than $\mu$, and a high variance denotes the presence of a narrow-textured window, instead of a cell including an OOI border. It is evident that the threshold strategy used for a large texture is not valid anymore.

In particular the presence of a cell inside an OOI can be detected by inverting the test on the variance, (i.e. $\sigma_i < \lambda_\sigma$), while no test based on the mean luminance will be significant. The drawback of a test completely based on the variance, is that it may become very critical if large windows $W_i$ are considered. In fact it is necessary to isolate very regular cells among irregular ones (with high variance) to have good performance of the method. Cells partially including an OOI could be erroneously discarded.

To overcome this problem the dimension of the analysis cell is adaptively changed every time a narrow-textured background is recognized.

5.3.1. Narrow texture with reduced cell dimension

A first choice for the cell dimension, also in presence of a narrow texture, has been $L_w = 10$, as in the case of large textures. Experiments with this value of $L_w$ and adopting the same threshold strategy described in section 5.2 poorly performed due to the exiguous number of cells completely included inside the OOIs (they scarcely affect the value of $\lambda_\sigma$), and the textured background with a high luminance global mean (referred to the value of $\lambda_\mu$). The problem can be explained by considering the distribution of the pixel intensity.

A typical luminance distribution in presence of large texture is represented in Fig. 5. It can be noticed that the mean value $\mu_i$ for an OOI is largely over the texture mean value $\mu$ (this is the background mean value). In this case also few OOI pixels in a $10 \times 10$ cell are able to bring up $\mu_i$ over the threshold $\lambda_\mu$. Moreover, the local variance $\sigma_i^2$ evaluated on the OOIs border cells is always over the threshold $\lambda_\sigma$. This is due to the low local variance of the background compared with the one related to a cell including an OOI. For these reasons the strategy presented in section 5.2 mainly based on global parameters $\lambda_\mu$ and $\lambda_\sigma$ gives very good performance.
The case of narrow textures is much more critical, due to the larger values of \( m u \) and \( \sigma \), as shown in Fig. 6. The effect due to a 10 × 10 cell is that the parameters of an OOI cell can easily be under the global thresholds \( \lambda_\sigma \) and \( \lambda_\mu \); in this case the reduction of the window size gives two different advantages:

a) in a cell over an OOI the relative number of OOI’s pixel is increased, so that the local mean \( \mu_i \) may be over the global threshold \( \lambda_\mu \);

b) in a cell over an OOI border the local variance value \( \sigma_i \) could be over the global threshold \( \lambda_\sigma \) because of the increased relative number of OOI's pixel, that will be the dominant factor in the local variance evaluation.

This statistical pre-processing strategy has given good experimental results; in particular in the image of Fig. 2 the area of the selected ROIs is approximately 20% of the original image. Thus the global OBI-FINDER complexity is reduced more than 60%, also taking into account the additional pre-processing complexity.

5.4. ROI detection in presence of bi-modal textures

Usually the acquired image exhibits a large textured background, thus the algorithm starts with a 10 × 10 analysis cell. In the case of a bi-modal texture a preliminary segmentation of different textured areas based on the global statistical parameters is performed, so allowing the choice of the correct threshold strategy in each area.

5.5. Total performances evaluation

The case represented in Fig. 2 can be considered as a typical image under processing, thus it is possible to evaluate the global performance of the method on the basis of this example. In particular, the OBI-FINDER complexity directly depends on the total number of statistical parameters to be evaluated. Without pre-processing, the variance \( \sigma^2_{k.i} \) must be evaluated for each pixel \((k,i)\) within the matrix A (notice that for each pixel the variance is evaluated on the basis of the data contained in the cell \( W_{k,i} \)). If \( W \) is the cell dimension (in the examined example \( W = 3 \)), the total number \( R \) of operations performed by the method can be written as

\[
R = MN(2W^2 + 1)
\]  

(4)

where \( M \times N \) is the size of the original image and the multiplier number \( (2W^2 + 1) \) is due by the variance equation 1 (it is the sum of the number of differences, square operations and the total sum required by the equation).

If a pre-processing strategy is adopted, the total operation number \( R \) must be recomputed. In particular, in order to segment the different kinds of background and in order to select the ROIs, the original image must be firstly divided in cells of \( L_W \times L_W \) dimension. In these ones the luminance mean \( \mu_i \) and the luminance variance \( \sigma^2_i \) must be evaluated. It must be noticed that the statistical parameters evaluation is used both for texture segmentation and ROI detection. So, the total number of operations \( P \) needed by the pre-processing phase can be written as

\[
P = 
\left( \frac{MN}{L_W^2} \right) (2L_W^3 + 1) + 
\left( \frac{MN}{L_W^2} \right) 2
\]

(5)

where \( L_W \) is the size of the pre-processing window (typically \( L_W = 10 \)). The first part of this equation is related to the variance contribution, while the second part is related to the luminance mean amount of operations (a global sum followed by a ratio).
As few cells are selected by the pre-processing strategy, the total number of operations required by the method becomes

$$R_p = P + M N \alpha (2W^2 + 1) \tag{6}$$

where $\alpha$ is the percentage of selected cells. In the examined example, this percentage is 3% of the total cell number, thus $\alpha = 0.03$.

At this point it is possible to define the OBI-FINDER complexity reduction $G$ due to the pre-processing phase, as

$$G = 1 - \frac{R_p}{R} \tag{7}$$

corresponding to $G \approx 0.86$ (that is 86%) in the examined example.

6. CONCLUSIONS

In the first part of this note a general overview of possible applications of stratospheric platforms has been presented. In particular, the differences and new interesting features comparing to the satellite case have been highlighted and described.

The second part of the paper is devoted to the definition of the concept "on-board data processing". It has been shows that in order to reach the goal of optimized system operations, automatic signal processing algorithms are requested.

In this scenario a new algorithm for SAR data processing has been described and results of its application have been discussed.

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