Bulgarian Academy of Sciences. Space Research and Technology Institute.
Aerospace Research in Bulgaria. 24, 2012, Sofia

ASSESSMENT OF INFORMATION EFFICIENCY AND DATA QUALITY FROM MICROSATELLITE FOR THE NEED OF ECOLOGICAL MONITORING

Roumen Nedkov

Space Research and Technology Institute – Bulgarian Academy of Sciences
e-mail: rnedkov@space.bas.bg

Abstract

In this paper a methodology for defining and assessment of information efficiency, data quality and their georeferencing is presented. The criteria, which the presented methodology is based on, are related to specific tasks in the implementation of ecological monitoring.

Keywords: *microsatellite, data quality, information efficiency, ecological monitoring*

Introduction

Microsatellites are high technology devices both for space investigation and Earth observation. By using low-cost nano-, micro-, and small satellites, it is possible to solve many theoretical and applied scientific problems. These tasks have been solved so far by using the "everything in one" technology based on big space satellites.

Microsatellites can be defined as "Flying Space Intelligent Multisensors". They are data sources for space information of different efficiency and quality. The usage of microsatellites for solving numerous theoretical and applied scientific problems is directly related to the information efficiency and the quality of data received on the basis of measurements.

The problem for defining information efficiency and quality of the data obtained from the measurements is significant because it is directly correlated to the technological characteristics of the onboard sensors and their functional applications [1].

Methodology for defining and assessment of information efficiency, data quality and their georeferencing

Definition of the criteria for assessment

On the basis of the observed phenomena and processes such as fires and floods and their impact on environment the following criteria for assessment of information efficiency and space data quality are defined:

- The received data should be with a relevant space resolution ensuring the detection and recognition of the phenomena;
- Since fires are connected with temperature variations, the space data must have the relevant spectral and radiometrical resolution;
- In case of flooding, atmospheric pollution, and oil spill, the data should have a high resolution time;
- For a faster localization of these phenomena, their georeferencing should be made in a near real-time mode.

Description of the methodology

The parameters that define the information efficiency and data quality are as follows:

- Space resolution
- Radiometrical resolution
- Spectral resolution
- Temporal resolution

The space dynamics of a specific phenomenon can be approximately presented by the following functions:

(1) $\Delta(X,t) = X_i(t) - Xs$

(2) $\Delta(Y,t) = Y_i(t) - Ys$

where Xs = image resolution on the axis X

Ys = image resolution on the axis Y

$X_i(t)$ and $Y_i(t)$ = temporal variations of the dimensions of the observed phenomenon.

If the values of the functions $\Delta(X, t)$ and $\Delta(Y, t)$ are positive, the phenomenon can be detected and identified on the image.

Spectral and radiometrical resolutions are predefined and correspond to previously known spectral characteristics of the observed phenomenon.The assessment is usually made by comparing the data with other data received from other sensors [1, 3].

The assessment of the temporal resolution is made on the basis of the period of data updating compared with the duration of the time interval in which the phenomenon is observed. If the time period of receiving of new data is less longer than the time duration of the observed phenomenon, the data are defined as efficient [4].

In order to achieve a near real-time mode, the following scheme can be applied in the data georeferencing:

1. Simulation rasters with the same space resolution as the real images are generated on the basis of ground control points with fixed coordinates.

2. The coordinates of the images are georeferenced to the relevant nudes of the coordinate grid on the earth's surface on the basis of the coordinates of the pattern rasters.

3. If there is a displacement of a shot image from the pattern image due to the orbital deviation, the georeferencing is implemented on the basis of the relevant identical points with the same coordinates. In this case, it is not necessary to generate a new coordinate grid but only to add or to remove nudes from the base coordinate grid.

The image displacement ΔX and ΔY to the base image and the relevant identical points **IP1** and **IP2** are shown on Fig. 1.

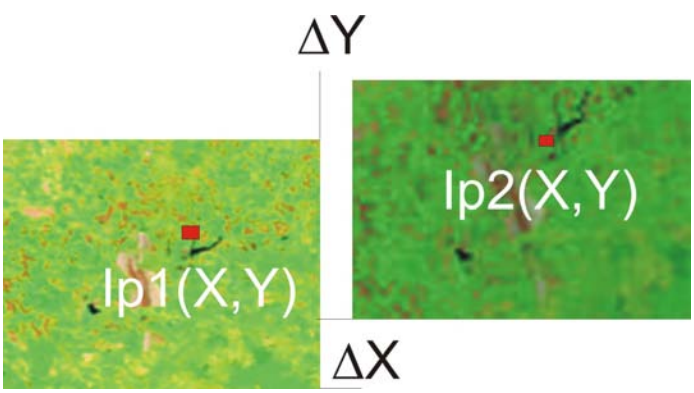

Fig. 1. Image displacement to the base image

The validation of the methodology for defining and assessment of information efficiency and data quality on the basis of the space, spectral, and radiometrical resolution is made by means of a specially-designed device for testing the quality of a multispectral sensor for microsatellite. The results are presented on Fig. 2 [2].

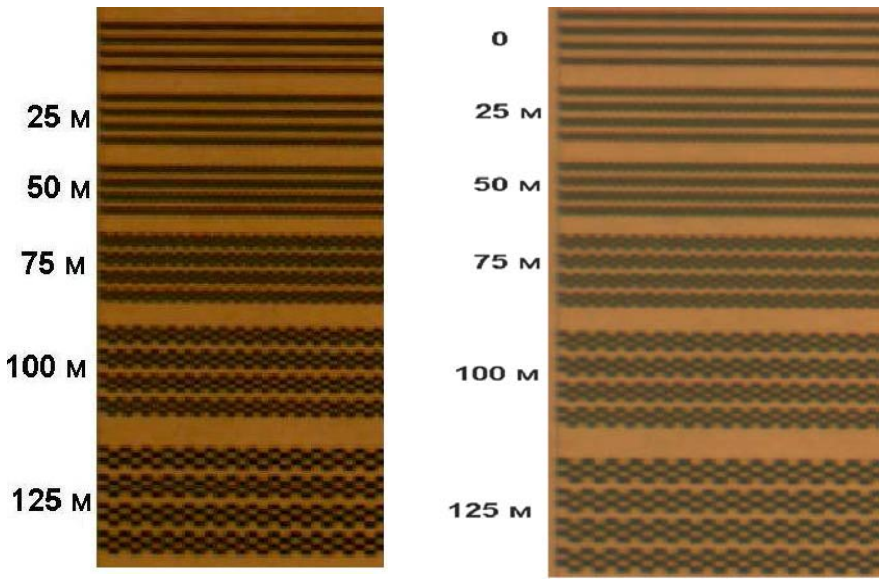

Fig. 2. The left part of the test image indicates the resolution quality of the limb of the image, whereas the right part – the resolution quality of its centre.

The methodology for achieving a near real-time mode in data georeferencing has been used for the Web-based ecological monitoring of atmospheric pollution in different parts of the territory of Bulgaria [4].

Conclusion

1. Criteria for defining and assessment of information efficiency and data quality on the basis of measurements as well as data georeferencing by using microsatellite platforms for ecological monitoring have been formulated.

2. A methodology for defining and assessment of information efficiency, data quality and data georeferencing has been proposed.

3. The results of the implementation of the proposed methodology are positive, which proves its practical applicability.

References

1. V l a d o v, M., D. D o b r o v, R. N e d k o v, M. K o l p a k o v i c h, D. U k r a i n t s e v. The scanner of remote sensing of the Earth. F i f t h S c i e n t i f i c C o n f e r e n c e w i t h I n t e r n a t i o n a l P a r t i c i p a t i o n S E N S 2009, 2 - 4 November 2009, Sofia.
2. V l a d o v, M., D. D o b r o v, R. N e d k o v, M. K o l p a k o v i c h, D. U k r a i n t s e v. The device for testing of a scanner of remote sensing of the Earth. F i f t h S c i e n t i f i c C o n f e r e n c e w i t h I n t e r n a t i o n a l P a r t i c i p a t i o n S E N S 2009, 2 - 4 November 2009, Sofia.
3. Z h u k o v, B., E. L o r e n z, D. O e r t e l. Experience of detection and quantitative characterization of fires during the experimental small satellite mission BIRD. Forschungsbericht, 2005-04. DLR. Köln.
4. Н е д к о в, Р., Е. Р у м е н и н а, Л. Ф и л и п о в, П. Х р и с т о в, М. Д и м и т р о в а, М. З а х а р и н о в а, В. Н а й д е н о в а, Г. Ж е л е в. Web-базиран мониторинг на атмосферните замърсявания в района на община Стара Загора на базата на спътникови данни. SENS 2007/2008, 264-273.

ОЦЕНКА НА ИНФОРМАЦИОННАТА ЕФЕКТИВНОСТ И КАЧЕСТВОТО НА ДАННИТЕ ОТ МИКРОСПЪТНИЦИ ЗА НУЖДИТЕ НА ЕКОЛОГИЧНИЯ МОНИТОРИНГ

Р. Недков

Резюме

В настоящата работа е предложена методика за определяне и оценка на информационната ефективност, качеството на данните от измерванията и тяхното георефериране. Критериите, на които се базира предложената методика, са свързани с определени задачи при извършване на екологичен мониторинг.