The satellite immages. Aquisition, validation and processing with new technology.

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Abstract:

Within the European Politics for Geographic Information, Geographic information represents a complex part in continous development of informational society having a wide range of aplicability. This can be categorized into: spatial, geographic information and descriptive, qualitative information. These two types of data can be integrated in the same information mamagement system by a Geographic Informational System. (*GIS*). With the end of realizing an infrastructure of spatial data at European and global level the implementation of the most recent acquisition techniques is pursued as well as the processing and the integration of data in an efective system of geospatial data.

Key Words: Geographic Informational System, georeferentiate points, DGPS, Spatial filters, digital modeling

1. Introduction –general background

Geographic information represents, within the European Policy for Geographic Information a complex part of information society which changes continously and which has a wide range of applicability. This can be groupped into two categories: spatial, geographic information and descriptive, qualitative information. These two types of data can be integrated within the same information management system by creating a Geographic Informational System.

The terrestrial surface can be represented starting from a series of measurements to determine the position of characteristic points after which these points shall be projected on a plane surface depending on how large the surface is. The position of these points is determined from other points the position of which is well known. These points form a an infrastructure which is called geodezic network.

The multitude of georeferentiate points form an image defining the structure of a map. In order to realize this map with the highest degree of accuracy and veracity, the immages aquired through various aquisition methodes are subject to more sophisticated techniques for modelling and processing.

2. Methodes for the determination of terrestrial geographic position and image

In what follows we will present the principles and the phenomena which lay at the foundation of GPS as well as the positioning systems used to obtain spatial data within the research project named “Inovative Technology for Marine and Terrestrial Scanning for digital modeling of ground”.

2.1. The principle for positioning by GPS with the use of radio signals on artifficial satelites.

By placing radio signal transmitters on artificial Earth satellites, the coverage aria is extended to the whole planet and thus we can "3-D" determine the coordinates of a point (latitude, longitude, altitude). Determining the position of a receptor requires knowledge of the distances from this receptor to the three transmitters compared to two as it was necessary in the case of terrestrial systems.

Another important difference is that now transmitters are mobile (they are not fixed(they move constantly on circumterrestrial orbites. This implies the need for highly accurate information on the parameters of the orbite as well as on the moment a determination took place. This information is contained in the complex signal emitted via the satellite. Moreover the respective satelites are permanently supervised from many stations set up in different locations on the globe having the mission to determine the corrections of the parameters of the orbites and the forecast of these perameters for the next 24 hours.

A "chain" of geodezic satellites that send necessary signals fot the positioning of location forms "a satellite navigation system". The most well known but not the only one is GPS. (Global Positioning System)

2.2. Positionning by DGPS

"Diferential GPS", is a concept that contains a series of measurement techniques to improve measurement accuracy (related to autonomous GPS positionning)

In fact, diferential measurements presupose the pinpointing (in a point called basis) of differences between the spatial position produced autonomously and the spatial position very well known by previous measurements.

These differences (also named differential corrections) are then applied either post-processing (in the bureau phase: post-processing DGPS) either in real time (in the field: real time DGPS)

There are a series of advantages in the case of post processing: redundancy, feedback, optimal filters of raw data, higher precision. The domain of milimeters in the case of derivate measurements recievers the ......phase.

2.3. Practical implications of reciprocal radio transmission by GDPS of the RTK type

The GPS user shall stop in the point for which altimetric and planimetric positionning is wanted only for the strict amount of time. Time is determined by various factors among which type of receivers (one or two frequencies with unidirectional or bidirectional radio transmission) the quality of radio modems, the distance from the GPS base of the mobile stations (rovers) the satellite configuration (the geographic one as well) the obstruction degree both at the base and in the rover, the latency of GPS receivers and last but not least the fixing/tracking degree on the same satellites of the base and of the rover.

The satellite configuration received by the base is transmitted by radio under the form of bynary list of the rover and this has to comply and to couple from the point of view of the received signal at the same satellites in the respective configuration.

There are two possibilities:

a)transmission is realized in uni-dimensional direction from the base to the rover.

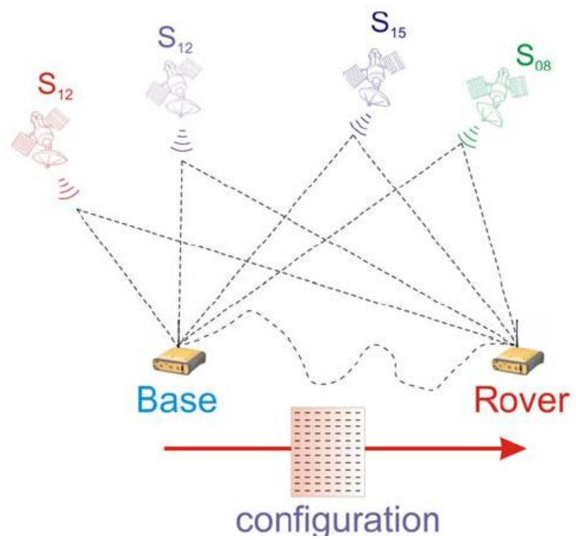

Fig. 2.3.1. uni directional transmission from base to the rover

b) transmission /communication is done in a bidimensional direction from base to rover and from rover to base

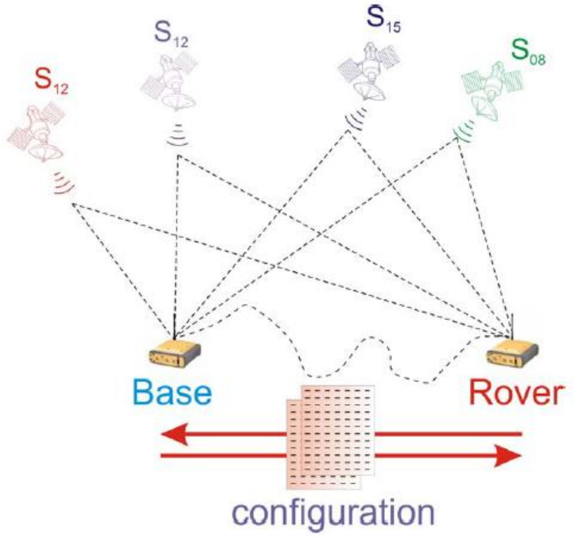

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Fig. 2.3.2. transmission from base to rover and from rove to base

3. Ways to remove noises.

The immage captured by the satellite is composed of information and noise from many sourses reminding of the noise produced by the sensor during the aquisition or the noise from digitized photographic document. Any operation that processes any pixel independently of the value of the neighbouring pixels, results in undiferentiated rise of the level of the noise and of the information in the immage.Whether it is Gaussian noise, uniform noise, salt and pepper noise, it is necessary that the resulting immages are subject to a corresponding minimizing noise level removal a prosess which is done by filtering. (mediation filters, filters orders.

3.1.**Spatial filters for noise removal**

The main categories of spatial filters used to remove noises are filters orders. and mediation filters.
filters orders. are non linear filters implemented by ordering the neighbouring pixels from the one with smaller value of gray levels to the one with the greatest value of the gray levels. This is done to select the „correct" value whereas in the case of mediation filters an average value of the neighbours was some way or other.

Mediation filters are as a rule linear filters applied by an operation of convolution of the immage with a nucleus of convolution and they function better with uniform noise or with Gaussian noise. filters orders. Work better with salt and pepper noises, negative exponential noises and Ryleigh noises.

In practice both filter types lose high frequency information when trying noise removal. A filter which changes behaviour relying on the characteristics of the gray levels of the neighbours is called an adaptive filter.

3. Aplication. DYNASCAN project. The inovative technology for integrated digital modeling terrestrial and undersea of coastal and riberane zones.

The used technology relies on the research and development of a solution of system interconection used in modern methods of relief investigation : LIDAR scanning (Light Detection and Ranging), high and low frequency echosounds scanning, unifascicle and rotative, positioning on the basis of global satelites system, assessement of the moving targets and syncronization.
To develop new technologies the project includes the realization of a prototype of inertial platforme equipped with complex underwater and over terrestrial scanning systems that can be placed both on ship and on ground, as well as the validation of new mixed water ground technologies as an alternative to unifunctional air solutions terestrial or marine.

This work is something new at national level. During the development of the project and with the end of the rehabilitation of the |Sulina cannal immages of the same type were processed and groupped in data sets as can be seen from the following immage.

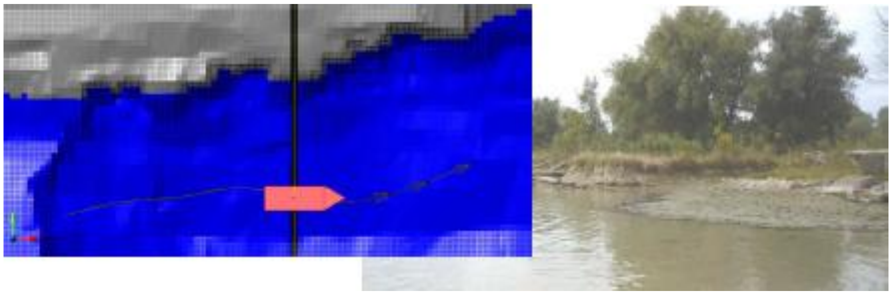

Fig. 4.1. Digital model of ground obtained by classical measurements o Sulina cannal.

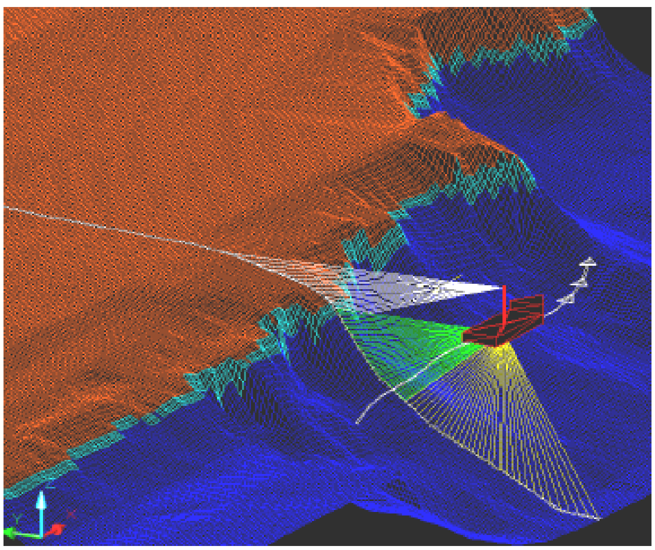

Fig. 4.2. Integrated relief scanning solution. Sulina Cannal.

Geometric processing of immages in the proceses that occur at the level of digital fotometric systems is done by the soft of digital fotometric application ti bring in coincidence the stereo immage plan with the plan on the field.

5. Conclusions and findings

The digital model of the field presented as application of the project is in compliance with requests for projecting and monitoring engineering works through objectivity, accuracy and the density of spatial data, as well as through the rapid provision of the final product, the rise in labour productivity the difficult arias included.

The linear filtering applied with the end of the improvement of immage quality calculates the new value of a pixel in the immage as a linear combination of a number of values in the original immage. Thios is done by a simple mediation mask. The move of the mask led to the concept of tehnica ferestrei glisante. The following coding system gives an exemple of this filtering by using a 3X3 mask of elements.

```
float w[3][3];
int img[ N ][ M ], img_out[ N ][ M ];

//copiez in imag. finala prima si ultima linie din imag. Originala

for( i=0; i < NRCOL; i++ )
{
img_out[0][i] = img[0][i];
img_out[N-1][i] = img[N-1][i];
}

//copiez in img. finala prima si ultima coloana din img. Originala

for( i = 0; i < N; i++ )
{
img_out[i][0] = img[i][0];
img_out[i][M-1] = img[i][M-1];
}
//filtrarea propriuzisa
for( i = 1; i < N-1; i++ )
for( j = 1; j < M-1; j++ )
img_out[i][j] = round(
w[1][1]*img[i][j] + w[1][0]*img[i][j-1] +
w[1][2]*img[i][j+1] + w[0][1]*img[i-1][j] +
w[0][0]*img[i-1][j-1] + w[0][2]*img[i-1][j+1] +
w[2][1]*img[i+1][j] + w[2][0]*img[i+1][j-1] +
w[2][2]*img[i+1][j+1] );
```

As a conclusion the fact must be noticed that the immages obtained are subject to a complex technologic process so that we can obtain from detailed content of these immages with a high degree of accuracy, the geometric position of the topographic objects.

Of course we must emphasize that during the whole process of data aquisition and processing, errors may appear that cummulate and in the end these must not surpass the current standards.

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