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PRESENTATION OF REMOTE EARTH SENSING BY MEANS OF MATLAB IN COSAR FORMAT

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Formats of the initial level data processing are considered. Radar image storage COSAR format and complete structure of its file are described. Examples of reading the COSAR file in MATLAB and ENVI software are given. The structure of the final product of the radar picture is considered. Features of presenting metadata obtained from radar images are shown. The article presents a flowchart of radiolocation image (RLI) conversion into COSAR radar data presentation format.

The most important tasks in the development and pre-commissioning of remote sensing data processing systems are to increase performance of software systems, to automate the pre-treatment process and to select results presentation format.

RS data processing is divided into preliminary and thematic [1].

– Pre-treatment - is a complex operation with images aimed at removing various RLI distortions. The distortions are due to the influence of adverse factors such as: the effect of the atmosphere; interference in the communication channels; geometric distortion methods of space imagery; analog-to-digital conversion of images. Pre-processing includes radiometric calibration, geo referencing, geometric correction of images and others.

– Topical treatment - a complex of operations with images, which allows to extract information needed to solve different thematic problems.

Most of the satellite systems transmit a stream of untreated "raw" data, which are recorded by ground receiving centre. The transmitted signal is a bit sequence containing both an earth shoot results and the service information about the motion of the spacecraft and the orientation of its modes of imaging equipment, and time markers al. (Metadata) [1].The received signal goes through several stages of pretreatment (demodulation, synchronization, decoding, and others), decompressing the received data stream, extracting images and associated service information, part of which is performed at the hardware level, with the help of the reception complex software. Processing results are presented in a variety of storage formats of the output product. The output product usually has the home directory, and a specific structure of subdirectories and files in which the data of the RLI supporting metadata are stored and.

The four formats that streamline data radar image (RLI) are usually used to provide a rough "raw" data corresponding to the processing level 0:

– Band Sequental, BSQ;
– Band Interleaved by Line, BIL;
– Interleaved by Pixel, BIP;
– The sequence of the zones compressed data to a file group coding method (for example, in jpg format).

In order to correctly reproduce the image of the data file formats it is necessary to know the structure, i.e., recording format and the number of lines and columns. The image files are usually provided with additional information related to the images: the description of the data file (the format, the number of rows and columns, resolution, etc.), statistics (distribution characteristics of brightness – minimum, maximum and mean, variance) and data on the map projection. Additional information can be found either in the header of the image file or in a separate text file with the same name as the image file name [2].

Remote sensing data processing, as a rule, is always carried out in a digital format, where the RLI is represented as a two-dimensional image. Data obtained in the same spectral region, i.e. using a radiolocating (RL) signal may be represented as a two-dimensional matrix of numbers A (i, j), each of which represents the intensity of the radiation received by the sensor element of the Earth surface, which corresponds to one pixel of the image. The image consists of n x m pixels, each pixel has coordinates (i, j) - line number and column number. The number placed in a matrix cell A (i, j) is an integer and is called the spectral brightness or gray level. If an image is obtained by multiple radio signals (several spectral bands) it is a three-dimensional table consisting of the numbers A (i, j, k), where k - spectral channel [2].

One of the most flexible formats for the presentation of basic data and metadata of a radiolocating image is COSAR format. COSAR file contains a complex form of satellite data received from SAR, which are grouped for package transmission and store information about the received reflected radio signal. The file can be in multiple packages, depending on the mode of satellite photography. If the SAR system uses multiple radio signals for each channel of the polarization, the information for each reflected signal is recorded in a separate file.

Formed package keeps the additional data and RLI data. These RLI may be suitable or unsuitable for further processing. Information on suitable and unsuitable data is stored as auxiliary data. Both auxiliary data and RLI data are stored in a rectangular matrix, and arranged so that it is sufficient simply to visualize the RLI itself. Figure 1 shows the arrangement of several data packets in the file.

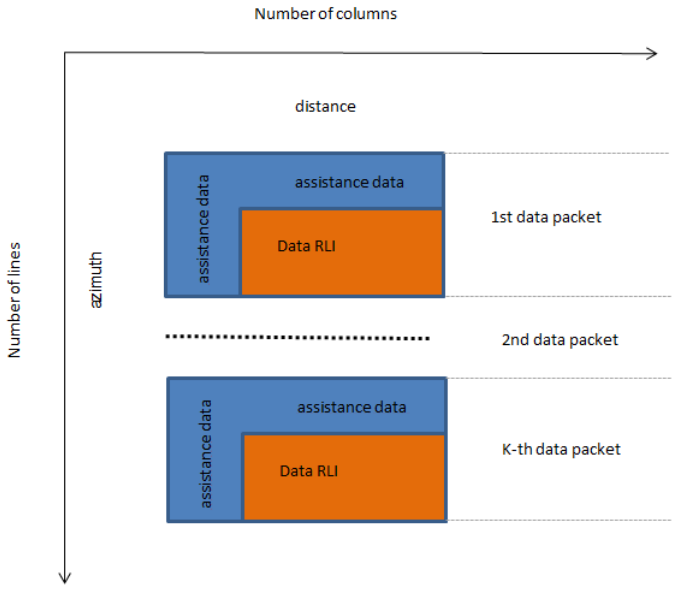

Fig. 1. Location of data packets in COSAR file

Since the data are arranged in a rectangular array, each column contains information about the range of the azimuth data, the division into cells occurs every 32 bits.

Auxiliary data are arranged in the first three rows of the range and at the beginning of each subsequent line. Auxiliary data of the first three lines are repeated in each formed package and contain information about the broadcast and general information about the generated file.

The following parameters are recorded in the first line of each packet: the number of bytes in current transfer; distance index, which reflects the relative location of the virtual raster of a first sample relative to the reference value range; the number of lines that store values in range; azimuthal number of columns; numbers radio code; total number of bytes in the line in the range direction; the total size of azimuth lines; sampling frequency of the first selection relative to the current selection range; COSAR file identifier and generated file version, two 32-bit numbers that define the file format; real variables of floating point (the order MSB) value is scaling back the speed of 1 / K used in data processing; other remaining 32-bit numbers to the end of each packet line are reserved for auxiliary data and internal use, which may contain additional modes of forming dependent information useful for interferometric processing of complex data.

The data format in a COSAR file is 32-bit numbers. These radar images are written in complex form: 16 bits for the imaginary part and 16 bits on the actual part. Byte order is reverse (the most significant byte (MSB) is the first). All auxiliary data is stored in a 32 bit integer. Cell named COSAR identifier is a 32-bit integer with a constant value in hexadecimal notation being 7F7F7F7F, and in the decimal notation the number is 1129529682. Information is read line by line, 32 bits per symbol. Line size is determined by RS + 2 or RTNB parameter [3].

Considering the structure and radar data presentation format in standard COSAR file, data representation MatLab algorithm in COSAR format was synthesized and implemented in the software, which is represented in block diagrams in Figure 4 and includes the following main steps: import of focused RLI with geometric correction; formation of the main auxiliary data based on imported RLI: raster size, COSAR ID file and its version. range index, number range of lines, the number of azimuth columns; number code of radio transmission; total number of bytes per line in the direction of range, the total size of azimuth lines, sampling frequency of the first selection relative to the current selection range; output in the first line of the file of the principal subsidiary, conversion of RLI, i.e. permutation of pixels for better adhesion to the 32-bit number of two 16-bit; the formation of auxiliary data skew, no warping in the default; conversion of all raster radar data into one-dimensional matrix, and in the resulting array of neighbouring glued two in one 32-bit number; the output of the auxiliary data and skew data in the RLI COSAR file.

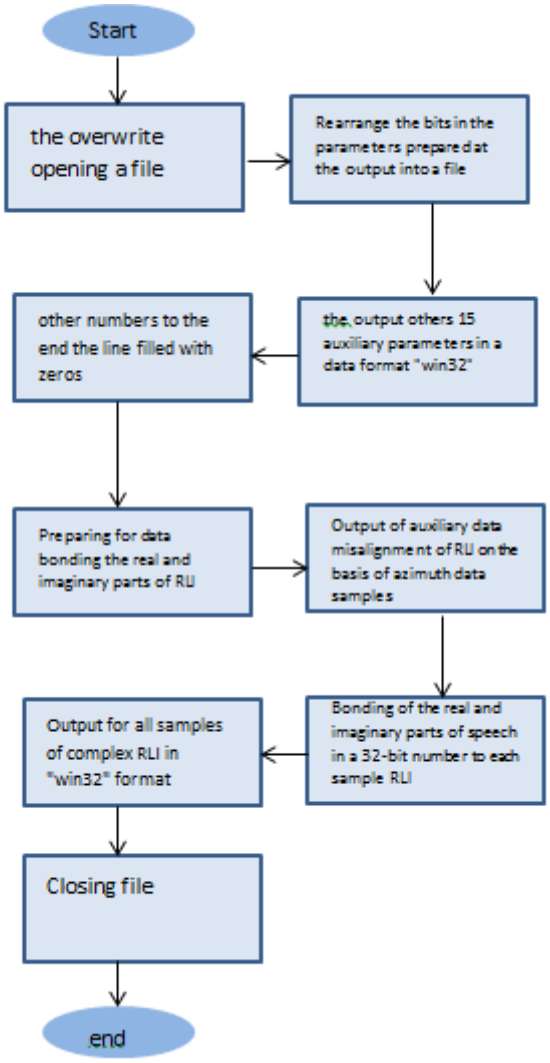

Fig. 2. A block diagram of a COSAR file formation algorithm

Figure 3 shows an example of the transformed algorithm developed by RLI in COSAR format.

а *б*

Fig. 3. Example of radar data format conversion:
a – a focused image of the satellite ERS-1 converted to COSAR format;
b – Open RLI COSAR synthetic format in ENVI

Conclusion. The algorithm is implemented in the Matlab software, it allows converting data into radio-location images of COSAR format. This significantly simplifies further processing of radar data for presentation in a form which corresponds to a standardized level data.

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