IMPROVE TECHNOLOGY SPATIAL RESOLUTION MULTICHANNEL IMAGE BASED ON A SYNTHESIS KNOWN TRANSFORMATIONS

V. Hnatushenko, L. Zagorodnyaya, V. Shevchenko

Summary. **A new algorithm to improve the informativeness of scanner images through the use of ICA-wavelet transforms and use pre-equalization. Testing this algorithm has confirmed its high efficiency in the processing of digital images obtained with modern aerospace systems.**

Keywords: **scanner images, ICA, wavelet transform, equalization, informative merger.**

Formulation of the problem. In remote sensing systems in recent years, widespread scanning device, which for imaging the earth's surface in the focal plane set several matrices charge-coupled receivers. Each of these imaging matrix provides a certain spectral range. The advantage of this type of scanners is that they are formed spatially combined images. However, the spectral radiant energy separation leads to weakening of the detected signal and reduce the distinction radiometric video. The actual area of modern scientific research is synergistic processing (fusion) of photogrammetric data multiple channels to produce an artificial image of informative indicators improved compared to the initial images and their subsequent analysis.

Analysis of recent research. Currently, there are different methods of combining photogrammetric images to enhance the information content of multispectral images: based on the transformation of HIS, PCA, Wavelet, Color Normalized (Brovey), ICA, Gram-Schmidt et al. [1-4]. However, the use of separate these algorithms usually leads to disruption of color.

The wording of Article purposes. Thus, there is need to develop multi-channel data acquisition technology to produce a synthesized image with improved performance decoding (informative) and lack of distortion in the resulting colored image.

Main part. The proposed technology synthesizes several phases of transformations of multispectral and panchromatic original image. A characteristic feature of most photogrammetric images is a significant proportion of dark areas and the relatively small number of sites with high brightness. So the first step invited to equalization and panhromnoho multispectral images with which adjusted the original image. Then create full color image pixel values are presented in a color system HSV (hue - the hue, saturation - saturation, volume - brightness) HSVmul, HSVpan [2].

By luminance component *V* is applied wavelet transform, whose scheme is shown in Fig. 1. The paper used discrete wavelet transform Daubechies. After wavelet inverse transformation processing is performed to the image color space RGB.

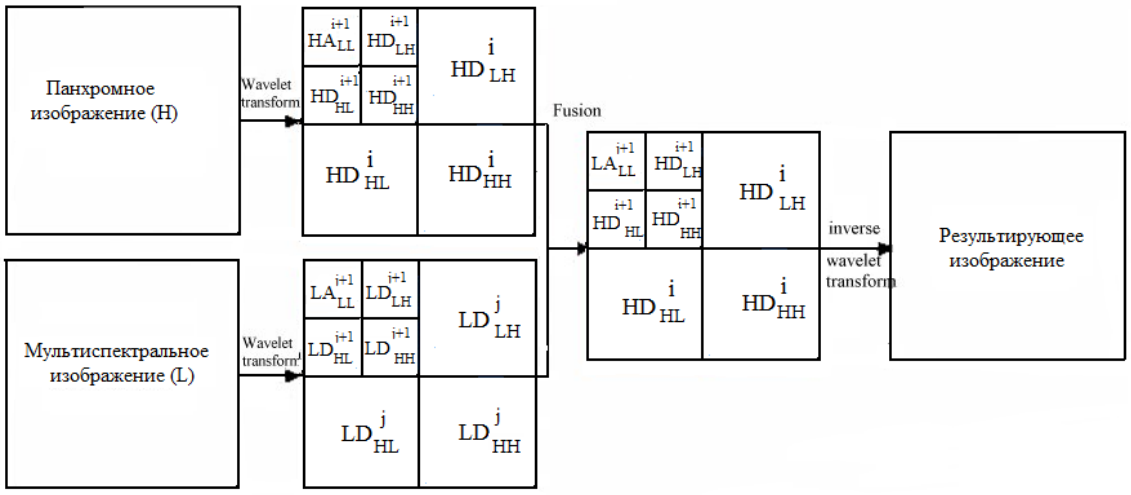

Fig.1. Step wavelet transform.

The next step is to determine statistically independent of the object, the selection and display their spectral contrast is the use of independent component analysis (ICA). ICA task is formulated as a problem finding this projection vector y on a linear space of vectors ***x***, the components of which would be statistically independent. This analysis is only a statistical sample values of some random vector ***y***. The algorithm we offer replacement ICA after the first component MUL-image component panchromatic image. The next step after reverse conversion options are ICA. Scheme of new technology combining digital multichannel image is shown in Fig.2. Fig. 3 shows the image: primary panhromne (Fig. 3, a) and multispectral (Fig.3, b) and the synthesized image after processing technology proposed in the (Fig. 3, c).

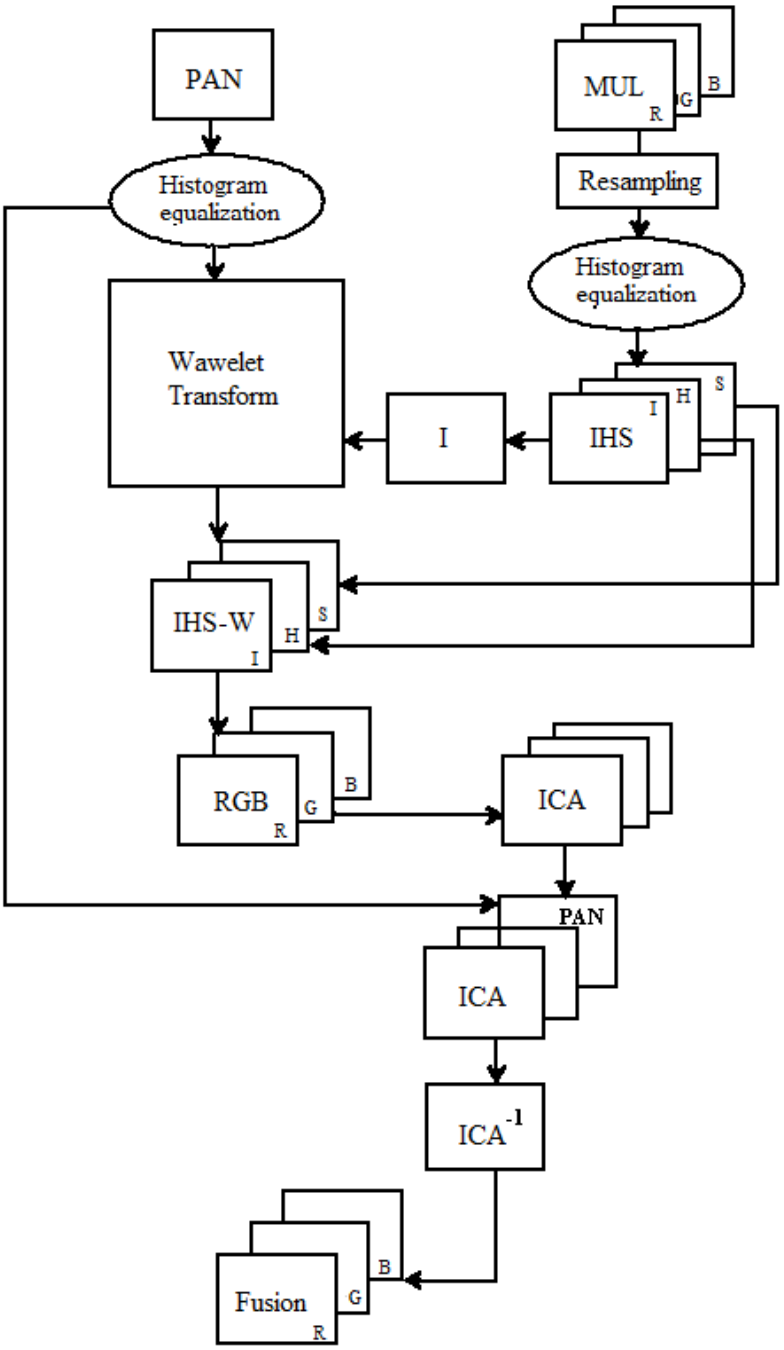

Fig. 2. Scheme technology combining images.

a)

b)

c)

Figure 3. Sample images:
a) primary panhrom b) the initial multispectr,
c) synthesized after treatment proposed algorithm.

An important role in digital image processing plays an assessment of their quality. As a measure of informativeness images are often used concept of Shannon entropy information that establishes the average amount of information per pixel image. For *A* halftone image density pixel luminance probability *p(A)* and an interval of possible values of brightness [0, 255], entropy is calculated as follows:

$$E(A) = -\sum_{k=0}^{255} p_k\,(A) * log_2\,[p_k(A)]. \qquad (1)$$

Often, as the evaluation also used the correlation coefficient, which reflects the correlation between the original and synthesized multispectral images. The higher the correlation between these images, the better the score spectral values. Perfect correlation coefficient is 1. For two digital images *A* and *B* using the following expression:

$$K = \frac{\sum_{i=1}^{N}\sum_{j=1}^{M}(A_{i,j}-\overline{A})\,(B_{i,j}-\overline{B})}{\sqrt{\sum_{i=1}^{N}\sum_{j=1}^{M}(A_{i,j}-\overline{A})\sum_{i=1}^{N}\sum_{j=1}^{M}(B_{i,j}-\overline{B})}}, \quad (2)$$

де $\overline{A}$,$\overline{B}$ — the average value of the corresponding data sets;
N, *M* — size images.

Quantitative assessment of the quality of the synthesized image compared to the original data are presented in Table 1. The table shows the calculated values of entropy (1) for outgoing and panhromnoho multispectral images and synthesized for the proposed image processing technology (image size 1000 * 1001 pixels).

Table 1.

Image	**The value of entropy**
Panchromatic (Pan)	7.3535
Multyspektralnыe (Mul)	7.4022
Images of the proposed algorithm	**7.5118**

Table 2 shows the correlation coefficient (2) for the synthesized multispectral images obtained separately by known methods merger (ICA, HSV, Wavelet) and in the proposed method. Analysis of the results shows that the synthesized image with maximum detail (informative) achieved with the proposed integration of technology with pre-equalization output images.

Table 2.

Method	**The coefficient of correlation**		
	R	**G**	**B**
ICA	0.951	0.942	0.911
HSV	0.968	0.964	0.967
Wavelet	0.953	0.965	0.964
Fusion	**0.982**	**0.970**	**0.973**

Conclusions. The parameters indicate that the result of processing multi-channel images using technology more informative generic remote sensing based Equalisation-HSV-wavelet transforms ICA synthesized image with higher quality and increased information content compared with the initial images. Further research will focus on the improvement of the proposed technology in the processing of multi-channel digital images involving information obtained in the infrared.

Literature

1. *Шовенгердт Р.А.* Дистанционное зондирование. Модели и методы обработки изображений. Часть 1/ Р.А. Шовенгердт - М.: Техносфера, 2010. - 560 с.
2. *Hnatushenko V.* Computer technology more informative multispectral images of the earth surface / V. Hnatushenko, A. Safarov // Applied Geometry and Engineering Graphics. - K.: KNUBA, 2012. - Vol. 89. – С. 140-144.
3. *Малла С.* Вейвлеты в обработке сигналов. Пер. с англ. / С. Малла. – М.:Мир, 2005. – 671с., ил.
4. *Pohl C.* Multisensor image fusion in remote sensing: concepts, methods and applications / C. Pohl, J.L. Van Genderen // International journal of remote sensing. – 1998. – Vol. 19. – No. 5. – P. 823-854.