RESTORATION OF SATELLITE IMAGES CORRUPTED BY STRIPE INTERFERENCE

Turebekov R.Z., Sultanov M.A., Kazantsev I.G.

Akhmet Yassawi International Kazakh-Turkish University, Turkestan, RK; Institute of Computational Mathematics and Mathematical Geophysics, Novosibirsk, RF

rauan.turebekov@ayu.edu.kz, murat.sultanov@ayu.edu.kz, kig@ooi.sscc.ru

Image enhancement approaches fall into two broad categories: spatial domain processing methods (spatial methods) and transform domain processing methods (Fourier tansform, or frequency methods, Laplace, Radon and other transforms). The term spatial domain refers to the image plane as such, and this category includes approaches based on direct manipulation of image pixels. Methods of processing in the frequency domain are based on the modification of the signal generated by applying the Fourier transform to the image [1].

Intermittent noise is usually caused by electrical or electromechanical interference during satellite image acquisition (the so-called "drift of dark currents") [2]. In this case the image is usually heavily distorted by spatial sinusoidal noise of various frequencies. Such noise can be significantly reduced by frequency filtering in the region of the Fourier transform. The main idea is that in the Fourier spectrum, periodic noise looks like a concentrated spike energy at the position corresponding to the frequencies of the periodic interference. An approach comes down to using a selective filter (notch, bandpass and narrowband), capable of isolating noise.

In this work we consider an alternative approach due to well-known mathematical relation of the Fourier and Radon transforms, and pay basic attention to the Radon transform, its singular value decomposition (SVD) into sums of ridge functions and its application to removal of strip interference. The Radon transform maps an image into a one-dimensional integral projection, which makes it possible to calculate the convolution and correlation of two images, linear and nonlinear filtering, compression and encoding of information in devices designed to process one-dimensional signals. The motivation of using the Radon transform is an observation that a sequence of strips is a ridge function. We need to extract a single ridge function (or few neighbors of it) from the distorted image. Compared to the frequency approach, projections of Radon space still retain their connection with spatial geometry.

We illustrate the results of extrating the strip interference in a real- world satellite images of remote sensing.

The work has been supported in the Framework of the State Assignment for the Institute of Computational Mathematics and Mathematical Geophysics of the Siberian Branch of the Russian Academy of Sciences (project no. 0251-2021-0003) and by the Ministry of Science of the Republic Kazakhstan (project no. AP 05133873).

REFERENCES

1. Gonzalez R.C., Woods R.E. Digital image processing, Pearson, New York, 2018.
2. *Song Q. et al.* Remote sensing images stripe noise removal by double sparse regulation and region separation // Remote Sensing, 2018, V. 10, No 7, 998.