NEW METHOD FOR ONBOARD COMPRESSION OF SATELLITE IMAGES

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ABSTRACT

Due to the conflict between increasing amount of data and restricted downlink transfer rate, onboard compression of satellite images before downloading has become an inevitable procedure.

Striping noise is an inherent factor that exists in the acquired satellite images[1], thus, for the onboard image compression, the impact of striping noise has to be considered. Image compression is based on continuity and correlation of neighboring pixels, for images with striping noise, two neighboring image lines varies distinctly in DN values and impairs the continuity. Although this variance is not valid image information, in image compression, it will be taken as high frequency component which costs more storage unit and is hard to be kept.

Compression experiment of the raw satellite images show that after compression, in homogeneous areas striping noise is smoothed out, whereas in heterogeneous areas such as edges, the noise still exists, and, with increasing of compression ratio, the noise degrades into irregular stripped and blurred blocks. The compressed images show abnormity on the image lines and edges. These effects may surely affect application of the data, especially for images of urban areas that describes the complicated and heterogeneous surfaces.

From the discussions above, for the onboard compression, algorithm adjustment has to be done taking striping noise into consideration. Besides, to achieve high speed real-time storing and transmission, compression onboard is always done with hardware, thus the specified raw data satellite image compression methods still need to be hardware adaptable. In this paper, taking the images from Beijing-1 small satellite as an example, origin and characteristics of striping noise are analyzed. Then, based on properties of striping noise, an improved method developed from the widely used JPEG compression algorithm is proposed for compression of raw data satellite

images. The new compression method is applied to Beijing-1 small satellite raw data images and yields significant boost in compression performance both in compression ratio and image results.

For simple JPEG compression, striping noise can be kept and acceptable destriping result can only be gained below the ratio of 4. With compression ratio greater than 4, irregular striped and blurred blocks emerges, and destriping does not make any sense, the images can not be used at all. However, with the proposed method, the compression PSNR with ratio of 6 is similar with the result with ratio of 4 for simple JPEG compression. Thus, for storing and transmission of compressed image with the same quality, 50% more data can be stored in the same storage unit or transferred with the same transfer rate. For visual interpretation, compressed image with ratio of 7 with the proposed method is still acceptable.

Besides, after compression the characteristics of striping noise are well kept. The destriped images [2] have better similarity to the destriped original images, and most importantly, with the improved method, the image information is well kept, edges of objects are clear of the abnormities, this improvement can surely facilitate application of the images. In this paper, improvements on segmentation are tested and illustrated.

To meet the high spatial resolution image demands from refined observations such as urban surveillance, more satellites with high spatial resolution will be launched and consequently increased amounted of data need to be transmitted. Compression of raw data satellite images has become an urgent issue that needs to be discussed. Researches in this paper solves the striping noise problem for on-board compression and provides new thoughts for compression of raw satellite images, the results can provide support for designing of onboard compression and transmission circuits. With the proposed method, advanced compression efficiency can be realized with modification of the circuits, and besides, no extra modification is needed to be done, post-processing of the compressed images is totally compatible with the original procedure. The method proposed here can also be as reference for satellite images that have the same characteristics.

REFERENCES

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