

## 多光谱遥感图像CCSDS动态码率控制近无损压缩

张宁<sup>1</sup>, 冯书道<sup>1</sup>, 濮建福<sup>1</sup>, 沈霁<sup>1</sup>, 吴红松<sup>1</sup>, 李贤<sup>1</sup>, 张雷<sup>2</sup>

1. 上海航天电子技术研究所, 上海 201109;
2. 沈阳航空航天大学, 辽宁 沈阳 110013

## Dynamic rate control for CCSDS nearly lossless compression of multispectral remote image

ZHANG Ning<sup>1</sup>, FENG Shu-yi<sup>1</sup>, PU Jian-fu<sup>1</sup>, SHEN Ji<sup>1</sup>, WU Hong-song<sup>1</sup>, LI Xian<sup>1</sup>, ZHANG Lei<sup>2</sup>

1. Shanghai Aerospace Electronic Technology Institute, Shanghai 201109, China;
2. Shenyang Aerospace University, Shenyang 110013, China

摘要

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**摘要** 基于空间数据系统咨询委员会(CCSDS-123.0-B-1)推荐的多光谱图像无损压缩算法,提出了一种前向自适应调整量化步长的码率控制方法以实现定码率近无损压缩.介绍了CCSDS标准的预测方法,分析了Golomb-Rice编码的上界与下界的范围.通过分析预测误差均值与压缩比的对应关系,建立了均值与压缩比之间近似线性映射曲线.根据预测误差均值,前向自适应估计量化步长,初步控制Golomb-Rice码长.考虑到星载条件下多光谱图像码率控制策略,通过压缩比反馈微调量化步长,实现压缩码率的精确控制.最后总结了CCSDS多光谱近无损压缩码率控制流程.实验结果表明, $k$ 值(Golomb编码变量)的分布区域稳定,在4:1压缩时,本文方法的峰值信噪比(PSNR)平均为60.42 dB,比单谱段JPEG2000、差分JPEG-LS压缩等方法提高了5.51 dB和2.89 dB.实验显示本文方法码率控制准确,易于硬件实现,适合航天工程使用.

**关键词** : 多光谱图像, 遥感图像, 近无损压缩, 空间数据系统咨询委员会(CCSDS)标准, 码率控制

**Abstract** : On the basis of CCSDS-123.0-B-1 lossless compression algorithm of multi-spectral image recommended by the Consultative Committee for Space Data Systems(CCSDS), a rate control method of forward adaptive quantifying step size was proposed to achieve the nearly lossless compression with a fixed rate. The prediction method of CCSDS was introduced and the ranges of the upper bound and lower bound of Golomb-Rice coding were analyzed. By analyzing the relationship between prediction error and the compression rate, their approximate linear mapping curves were established. According to the mean value of prediction error, the quantization step size was adaptively estimated and the Golomb-Rice coding length was preliminarily controlled. In addition, taking the multi-spectral image rate control strategy under spaceborne conditions into account, the compression code rate was precisely controlled by fine tuning the quantization step size according to the feedback of compression rate. At last, the processes of CCSDS nearly lossless compression rate control method was presented. The experiment results show that distribution area of  $k$  (Golomb coding variables) is stable. At the compression rate of 4:1, the Peak Signal to Noise Ratio(PSNR)from the proposed method is 60.42 dB averagely, which is increased by 5.51 dB and 2.89 dB as compared with those from JPEG2000 and differential JPEG-LS methods respectively. The rate control method is accurate, easy to be implemented in hardware and suitable for aerospace engineering.

**Key words** : multispectral image remote sensing image nearly lossless compression standard of Consultative Committee for Space Data Systems(CCSDS) code rate control

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**作者简介**: 张宁(1982-),男,山东济宁人,高级工程师,工学博士,2006年于吉林大学获得学士学位,2012年于中国科学院长春光学精密机械与物理研究所获得博士学位,主要研究方向为图像处理、星载电子学等领域.E-mail:dzs\_zhangning@163.com冯书道(1984-),男,湖南岳阳人,高级工程师,2009于上海交通大学获得硕士学位,主要研究方向为星载图像压缩、基带数字信号处理领域.E-mail:feng\_shu\_yi@aliyun.com

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地址: 长春市东南湖大路3888号 邮编: 130033 E-mail: gxjmgc@sina.com

