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信息科学

基于自适应指数哥伦布编码的图像压缩算法

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摘要: 在徐勇等人提出的适用于硬件的低复杂度算法的基础上, 提出了一种基于自适应指数哥伦布编码的图像压缩算法来进一步提高压缩性能。首先, 对图像进行4级5/3小波变换; 根据小波变换后的子带数据进行建模, 得到最佳量化步长。然后, 采用JPEG_LS算法预测量化后的LL子带, 并对各个子带数据进行零游程编码。最后, 对零游程编码得到的数据进行自适应指数哥伦布编码。实验表明: 当比特率大于0.25 bpp时, 本算法略好于徐的算法; 当比特率小于0.25 bpp时, 本算法重构图像的峰值信噪比较徐的算法高0.2~2 dB。结果显示, 本算法不仅提升了压缩性能, 而且由于指数哥伦布编码级数更新模型复杂度很低, 完全可以用硬件实现。

关键词: 图像压缩 小波变换 量化建模 自适应指数哥伦布编码

Image compression algorithm based on adaptive exp-Golomb coding

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Abstract: According to the low-calculation image compression algorithm introduced by Xu Yong, et al., a new image compression algorithm based on adaptive Exp-Golomb coding was proposed to implement the high-speed image compression. Firstly, the image with 4-level 5/3 was transformed with wavelet transform to obtain the optimal quantization step for each wavelet subband according to wavelet subband data model. Then, the JPEG_LS algorithm was employed to predict the value for the LL subband and to encode for all the wavelet subband data in the Zero-Run-Length algorithm. Finally, the adaptive Exp-Golomb coding was adopted to encode the data after Zero-Run-length algorithm. Experiment results show that the proposed algorithm can achieve a little better performance than Xu's algorithm, when the bit rate is greater than 0.25 bpp; and the Peak Signal-to-noise Ratio (PSNR) of the proposed algorithm can increase by 0.2-2 dB when the bit rate is less than 0.25 bpp. It means that the algorithm improves the performance of compression. The Exp-Golomb coding model is extraordinary simple and can be implemented by the hardware completely.

Keywords: Image compression Wavelet transform quantization model adaptive Ex-Golomb coding

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参考文献:

- [1] SHAPIRO J M. Embedded image coding using zerotress of wavelet coefficients [J]. IEEE Transactions on Signal Processing, 1993, 41(12): 3445-3462.
- [2] SAID A, PEARLMAN W A. A new, fast and efficient image codec based on set partitioning in hierarchical trees [J]. IEEE Transactions on Circuits and Systems for Video Technology, 1996, 6(3): 243-250.
- [3] ISLAM A, PEARLMAN W A. An embedded and efficient low-complexity hierarchical image coder [J]. Proceedings of SPIE, 1999, 3653(1): 294-305.
- [4] TAUBMAN D. High performance scalable image compression with EBCOT [J]. IEEE Transactions on Image Process, 2000, 9 (7): 1158-1170.
- [5] 卫俊霞, 相里斌, 段晓峰, 等. 基于EZW的高光谱图像压缩技术研究 [J]. 光谱学与光谱分析, 2011, 31(8): 2283-2286.
- [6] WEI J X, XIANG L B, DUAN X F, et al. Hyperspectral image compression technology research based on EZW [J]. Spectroscopy and Spectral Analysis, 2011, 31(8): 2283-2286. (in Chinese)
- [7] 徐勇, 张启衡. 基于游程和扩展指数哥伦布编码的任意形状感兴趣区域图像编码 [J]. 光学 精密工程, 2011, 19(1): 175-182.
- [8] XU Y, XU ZH Y, ZHANG Q H. Arbitrary shaped ROI image coding using Run-length coding and generalized Exp-Golomb coding [J]. Opt. Precision Eng., 2011, 19(1): 175-182. (in Chinese)
- [9] 王建军, 刘波. 适于硬件实现的无损图像压缩 [J]. 光学 精密工程, 2011, 19(4): 922-928.
- [10] WANG J J, LIU B. Hardware implementation of lossless image compression [J]. Opt. Precision Eng., 2011, 19(4): 922-928. (in Chinese)
- [11] 汤毅, 辛勤, 李纲, 等. 基于内容的高光谱图像无损压缩 [J]. 光学 精密工程, 2012, 20(3): 668-674.
- [12] TANG Y, XIN Q, LI G, et al.. Lossless compression of hyperspectral images based on contents [J]. Opt. Precision Eng., 2012, 20(3): 668-674. (in Chinese)
- [13] 刘晶, 王映辉, 刘刚, 等. 基于几何方向的图像压缩算法 [J]. 电子学报, 2011, 39(7): 1693-1697.
- [14] LIU J, WANG Y H, LIU G, et al.. Image compression based on geometrical direction [J]. Acta Electronica Sinica, 2011, 39(7): 1693-1697. (in Chinese)
- [15] 张军, 成礼智, 杨海滨, 等. 基于纹理的自适应提升小波变换图像压缩 [J]. 计算机学报, 2010, 33(1): 184-192.
- [16] ZHANG J, CHENG L ZH, YANG H B, et al.. Adaptive lifting wavelet transform and image compression via texture [J]. Chinese Journal of Computers, 2010, 33(1): 184-192. (in Chinese)
- [17] 田杰华, 顾晓

东, 汪源源. 利用人眼视觉特性的低比特率小波图像压缩 [J]. 仪器仪表学报, 2010, 31(11): 2515-2521. TIAN J H, GU X D, WANG Y Y. Low-bit-rate wavelet-based image compression using human visual characteristics [J]. Chinese Journal of Scientific Instrument, 2010, 31(11): 2515-2521. (in Chinese) [12]徐勇, 徐智勇, 张启衡, 等. 适于硬件实现的低复杂度图像压缩 [J]. 光学精密工程, 2009, 17(9): 2262-2268. XU Y, XU ZH Y, ZHANG Q H, et al.. Low complexity image compression scheme for hardware implementation [J]. Opt. Precision Eng., 2009, 17(9): 2262-2268. (in Chinese) [13]吴乐南. 数据压缩 \[M\]. 2版. 北京: 电子工业出版社, 2005. WU L N. Data Compression \[M\]. 2nd ed. Beijing: Publishing House of Electronics Industry, 2005. (in Chinese) [14]WOODS J W, NAVEEN T. A filter based bit allocation scheme for subband compression of HDTV [J]. IEEE Transactions on Image Processing, 1992,1(3): 436-440. [15]朱明, 高文, 郭立强. 压缩感知理论在图像处理领域的应用 [J]. 中国光学, 2011,4(5):441-447. ZHU M, GAO W, GOU L Q. Application of compressed sensing theory in image processing [J]. Chinese Optics, 2011, 4(5):441-447. (in Chinese) [16]李桂菊. 利用DSP底层结构提高MPEG-4编码的实时性 [J]. 中国光学, 2011, 4(5): 461-467. LI G J. Improvement of real-time properties of MPEG-4 encoder by DSP underlying structure [J]. Chinese Optics, 2011,4(5):461-467. (in Chinese)

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1. 宋蓓蓓 孙文方. 精确质量控制的遥感图像JPEG2000压缩方法 [J]. 光学精密工程, 2013,21(8): 2180-2186
2. 张立保 丘兵昌. 基于快速方向预测的高分辨率遥感影像压缩 [J]. 光学精密工程, 2013,21(8): 2095-2102
3. 周丽平 孙志峻 张泉. 显微视觉自动聚焦及控制策略 [J]. 光学精密工程, 2013,21(3): 807-812
4. 蒋慧琴 李萍 王忠勇 刘玉敏. 医学图像感兴趣区域近无损压缩 [J]. 光学精密工程, 2013,21(3): 759-766
5. 刘春香 郭永飞 李宁 司国良 李云飞. 星上多通道遥感图像的实时合成压缩 [J]. 光学精密工程, 2013,21(2): 445-453