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Scalable Line-Based Wavelet Image Coding in Wireless Sensor Networks

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Abstract

Existing scalable wavelet image coding approaches, such as set partitioning in hierarchical trees and its derivatives, employ a memory-intensive tree-based coding structure. Existing tree-based wavelet coding approaches are therefore not suitable for memory-constrained sensor nodes. In this paper, we introduce a scalable wavelet image coding approach based on a line structure that requires very little memory. The proposed line-based approach is suitable for scalable wavelet image coding in memory-constrained sensor nodes, requiring only a few kilobytes of memory for a 256×256 pixel image. The presented line-based wavelet coding algorithm accesses the image data line by line and thus conforms with the data access patterns in current flash memory technology. Our performance evaluations demonstrate that the proposed scalable line-based image wavelet coding approach has no overhead compared to one-run (non-scalable) wavelet image coding and has competitive compression performance compared to JPEG 2000 and the recent Google WebP image format.

Keywords: Low-memory image coding, Sensor node Scalable image compression, Wavelet image coding.

1. Introduction

1.1. Motivation: Scalable Image Coding and Communication

Scalable image coding generates a base stream providing a low (base) image quality as well as scalable (refinement) streams that successively improve the image quality. Scalable image coding is a promising technique for image communication in bandwidth constrained networks, such as wireless sensor networks, since the base image quality can be displayed at the receiver after the first bytes of the base stream have been received. As scalable (refinement) streams are received, the image quality is improved.

Wavelet transform based image compression achieves superior image quality when using extremely high data compression [1, 2]. High compression is especially useful for

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