Chapter XVI

A Simple Prediction Method for Progressive Image Transmission

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BPM is a simple and intuitive method to implement the progressive image transmission. However, its reconstructed image quality at each of the beginning stages is not good. In this paper, we propose a simple prediction method to improve the quality of the reconstructed image for BPM at each of the beginning stages. By partitioning the input image into smaller blocks, our method transmits an important part of the pixel information of each block to the receiver in each stage. To reconstruct the whole image, the receiver recovers the missing pixel information in each block by linear prediction based on the transmitted pixel information. The experiment results show that our method can significantly improve the reconstructed image quality at each of the beginning stages compared to the BPM and IBPM proposed previously.

INTRODUCTION

Due to the thriving development of the computer network, digital images have been widely used in our daily lives. Hence, image transmission becomes an important issue in many applications, such as telebrowsing, teleconferencing, homepage-browsing on the World Wide Web (WWW), and so on. In general, the size of image data is usually very large and the transmission rate of the network is usually low due to its high loads. It takes the receiver much time to browse an image while this image is delivered via the network. In addition, the

receiver is unable to determine whether the image is useful or not unless the image is transmitted completely. The above problem can be solved by progressive image transmission (PIT). Generally, the PIT technique divides the transmission into several stages. In the first stage, the PIT system transmits a part of the image information to the receiver, and the receiver can reconstruct a low-resolution image according to the received image information. The low-resolution image is progressively improved by subsequent transmission stages. If the receiver concludes that the image quality is good enough and this is it or that the image is not required any more, he/she can interrupt the transmission. Otherwise, the full-resolution image will be completely reconstructed. The primary advantage of PIT is that an approximate structure of the image can be immediately displayed at the beginning stage of the transmission process. Thus, the viewer can determine as soon as possible whether or not to continue further transmission.

In the past decade, many articles on progressive image transmission have been proposed (Chen and Chang, 1997; Jiang, Chang, and Chen, 1997; Chang, Shiue, and Chen, 1999; Chang, Jau, and Chen, 1998; Tzou, 1987; Dubois and Moncet, 1986; Kim and Song, 1996; and Burt and Adelson, 1983). Tzou classifies their methods into three categories (1987): spatial domain (Chen and Chang, 1997; Jiang, Chang, and Chen, 1997; Chang, Shiue, and Chen, 1999; and Chang, Jau, and Chen, 1998), transform domain (Tzou, 1987; and Dubois and Moncet, 1986); and pyramid-structured progressive transmissions (Kim and Song, 1996; and Burt and Adelson, 1983). The most instinctive method for PIT in the spatial domain is the bit-plane method (BPM). However, the quality of the reconstructed image in BPM at earlier stages is not even acceptable. In order to improve the image quality of BPM, an improved bit-plane method (IBPM) was proposed recently (Chang, Shiue, and Chen, 1999). This method certainly increases the reconstructed image quality significantly, but it has to waste some extra bit rates for transmitting the tree-structured codebook. In this paper, we shall propose a simple method for PIT. Its main idea is to uniformly partition the input image into non-overlapping square blocks. Each block contains several pixels. The sender transmits a part of the pixel information in each block to the receiver in each stage. At the receiver side, the missing pixel information in each block is recovered by the linear prediction based on the known information. This prediction method can indeed improve the image quality at each of the beginning stages.

This chapter is organized as follows. The next section reviews the processes of the original BPM and IBPM and the *Proposed Method* section describes the method. The experimental results are shown and discussed in the section following. Finally, the conclusions are given in the last section.

PREVIOUS WORKS

BPM may be the simplest and most intuitive method for PIT in the spatial domain (Chang, Jau, and Chen, 1998). However, its reconstructed image quality is not desirable. IBPM is another PIT method to improve the image quality of BPM. This method improves the image quality by transmitting additional image information. In this section, we shall introduce these two relative methods.

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