Chapter 5
Adaptive Edge-Preserving Smoothing and Detail Enhancement for H.263 and H.264 Video

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ABSTRACT

For removing undesirable artifacts in video coding, a large number of filtering methods have been proposed as post-processing and in-loop processing. This chapter proposes a pre-processing method of motion-adaptive edge-preserving smoothing and detail enhancement for H.263 and H.264 video, in which temporal and spatial edges are used to define Region Of Interest (ROI). In the proposed pre-processing method, trilateral filtering with three types of weights (domain, range, and temporal weights) is used for smoothing non-ROI region while preserving temporal/spatial edges. In the proposed pre-processing method, the temporal weight preserves
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temporal edges within ROIs and smoothes details within non-ROI. The proposed pre-processing method can make video coding more efficient under the restricted bit-rate condition. The parameter values for weight functions of a trilateral filter are selected depending on the classification of motion and edginess, and proper filtering is performed with adaptive parameter values. Experimental results with a number of H.263 and H.264 test sequences show the effectiveness of the proposed method in terms of the visual quality, the peak signal-to-noise ratio, and the mean opinion score.

INTRODUCTION

In recent years, rapid increase in the number of cellular customers has led to significant development of mobile network system. Expansion of high data-rate communication in multimedia and data services requires a wide range of bandwidth up to 50–100 Mbps. Applications combined with streaming multimedia services such as real-time conversational voice services, point to point interactive multimedia services including interactive real-time voice, video, and other media (video telephony and white boarding), and video conferencing over wireless have been increasingly becoming a significant part of services in mobile vendor market (Etoh & Yoshimura, 2005). In particular, video coding technology is an important part of video streaming services for data transmission and storage.

To ensure video quality on these multimedia services, based on streaming with the encoder such as H.263, H.264, and moving picture experts group-4 (MPEG-4), an effective video enhancement algorithm is required for high-quality images/videos under the low bit-rate and restricted bandwidth. To achieve high quality, it is important to reduce various artifacts such as block artifacts, ringing artifacts, and false-color artifacts. In particular, a video coding algorithm with block-based transform, quantization, and motion prediction produces very annoying block artifacts with low bit-rate and high Quantization Parameter (QP) values (Kim & Jeong, 2007). These artifacts are amplified in multimedia services under the embedded mobile environment such as music video, which contains a large amount of motion and illumination variation between successive frames. Many image/video enhancement approaches have been developed to reduce the artifacts.

Most of deblinking algorithms are post-processing algorithms (Kim et al., 1999; Su et al., 1999; Yu et al., 2004; List et al., 2003). For example, overlapped block motion compensation (Su & Mersereau, 2000) and a post-processing algorithm which applies a smoothing filter according to the amount of detected block artifact (Yu & Zhang, 2004) were proposed. A deblinking algorithm was proposed by adaptively selecting a filter in boundaries (List, Joch, Lainema, Bjontegaard, &
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