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Moving object detection in wavelet compressed video ☆

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Abstract

In many surveillance systems the video is stored in wavelet compressed form. In this paper, an algorithm for moving object and region detection in video which is compressed using a wavelet transform (WT) is developed. The algorithm estimates the WT of the background scene from the WTs of the past image frames of the video. The WT of the current image is compared with the WT of the background and the moving objects are determined from the difference. The algorithm does not perform inverse WT to obtain the actual pixels of the current image nor the estimated background. This leads to a computationally efficient method and a system compared to the existing motion estimation methods.

Keywords: Moving region detection; Wavelet compressed video

1. Introduction

In many surveillance systems, the video is compressed intra-frame only without performing motion compensated prediction due to legal reasons. Courts do not accept predicted image frames as legal evidence in many countries [5]. As a result, a typical surveillance video is composed of a series of individually compressed image frames. In addition, many practical systems have built-in VLSI hardware image compressors directly storing the compressed video data coming from several cameras into a hard-disc. The main reason for this is that standard buses used in PC's cannot handle the raw multi-channel video data. In this paper, it is assumed that the video data is available in wavelet compressed format. In many multi-channel real-time systems, it is not possible to use uncompressed video due to available bus and processor limitations. The proposed moving object detection algorithm compares the wavelet transform (WT) of the current image with the WTs of

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Fig. 6. Detection result of the subband domain method using all of the 3rd level wavelet coefficients. Walking man marked as MAN1 is pointed.

coefficients. Because, 4th level wavelet coefficients are obtained after four consecutive down-sampling steps, and a 16×16 object reduces to a 1×1 object. In our software implementation, we ignore isolated coefficients to eliminate noise. Therefore, the method works up to the 4th level subband decomposition.

5. Conclusion

We developed a method for detecting motion in wavelet compressed video using only subband domain data without performing inverse wavelet transform. Our results assure us that the motion detection performance of the wavelet domain method is almost the same as methods using actual pixel data for motion detection. This is an expected result because subband domain data contains all the necessary information to reconstruct the actual image.

The main advantage of the proposed method compared to regular methods is that it is not only computationally efficient but also it solves the bandwidth problem associated with video processing systems. It is impossible to feed the pixel data of 16 video channels into the PCI bus of an ordinary PC in real-time. However, compressed video data of 16 channels can be handled by an ordinary PC and its buses, hence real-time motion detection can be implemented by the proposed algorithm.

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