多媒體訊號處理 (III) – 總計畫
Multimedia Signal Processing (III)
計畫編號: NSC90-2213-E-002-093
執行期限:90 年 8 月 1 日至 91 年 7 月 31 日
主持人貝蘇章 台灣大學電機系教授

摘要

在影像分析研究的資料中，以 Wipe 方式的換景為所有需要偵測的片段中最困難的一項。此論文中，我們提出一個簡單使用 Macroblock 資訊分析的方法，就可以迅速偵測 Wipe 片段，而此方法最大的優勢在於，不論此一 Wipe 片段的介入方向、換景形狀甚至是否帶有位移，本方法都可以直接且有效的在 MPEG 壓縮的影片中尋得 Wipe。

關鍵字:Wipe 偵測、影像分析、換景

Abstract

For video scene analysis, the wipe transition is considered most complex and difficult to detect. In this paper, an effective wipe detection method is proposed using the macroblock(MB) information of the MPEG compressed video. By analyzing the prediction directions of B frames, which are revealed in the MB types, the scene change region of each frame can be found. Once the accumulation of the scene change regions covers most area of the frame, the sequence will be considered a motionless wipe transition sequence. Besides, uncommon intra-coded MBs of the B frame can also be applied as an indicator of the motion wipe transition. A very simple analysis based on small amount of MB type information is sufficient to achieve wipe detection directly on MPEG compressed video. Easy extraction of MB type information, low-complex analysis algorithm and robustness to arbitrary shape and direction of wipe transitions are the great advantages of the proposed method.

Keywords: MPEG, scene change, scene cut, wipe detection, video analysis.

Introduction

As the rapid development of multimedia applications, the video database is growing extremely huge. Nowadays, the video database management and video retrieval system have also become an urgent issue to be solved. To achieve the goal of video database management, how to parse a video sequence into a set of key frames plays a very important role. Video analysis, which detects those frames carrying significant information, such as scene changes or caption embedded frames, acts as the fundamental step to facilitate the video retrieval and browsing mechanism. Recently, as a result, the scene change detection method arouses more and more interests and many related algorithms have been proposed. Generally, scene changes are subjectively divided into two types, abrupt scene change and gradual scene change, each represents different characteristics and requires different detection methods. Abrupt scene change, defined as sudden change from one scene to another caused by the video editing action, can be detected either by histogram comparison [3] on the uncompressed video, or by DCT coefficient comparison [4][5] and analysis on motion vectors [6][7] on the compressed video. We also have proposed an effective abrupt scene change detection based on an analysis of macroblock information, which explores and reuses comparison operations of the motion estimation procedure and can be applied directly on the MPEG compressed video. Compared with abrupt scene changes, however, gradual scene changes not only require more complex detection method but also probably produce disturbances on the abrupt scene change detection. It is a transition from one scene to another, which may take from several to several tens of frames. Most of gradual scene change detection papers have put their focus on the dissolve transition, during which the current scene gradually fades out and next scene gradually comes into sight. We also have proposed a dissolve sequence detection using macroblock information of P and B frame in the MPEG coding scheme, which explore the relationship between dissolve formula and the statistics of interpolated MBs.

Besides the dissolve sequence, there also exists another common gradual scene change, the wipe transition. During the wipe transition, the next scene gradually shows up and wipes out the current scene. Compared with the dissolve sequence, the wipe sequence detection method is less discussed and much more complex. The difficulties of wipe detection lie in four respects:

(1) The arbitrary shape: The wipe shape can be arbitrary, such as rectangular, circle, fencing, etc.

(2) The arbitrary direction: The wipe direction can be arbitrary, such as bottom to top, top to bottom, bottom-left to top-right, etc.

(3) The arbitrary speed: The wipe speed of a wipe transition can be arbitrary, which may spread over from several to several tens of frames.

(4) Foreground or background movement: The next wipe-in scene or the current wipe-out scene can gradually appear or disappear with motion instead of motionless appearance or disappearance.

Based on the above discussion, the richness of variety of wipe transitions makes it the most difficult gradual scene change to be detected. Some of related approaches perform the wipe detection based on uncompressed video.

Although good performance is obtained, high computation load is required to handle the different shapes, directions and patterns of the wipe effects. Additionally, as the MPEG standard is widely adopted, more and more video data are compressed in order to save the storage space. In other words, uncompressed video wipe detection has to spend additional computation power to decompress MPEG coded video in advance. As a result, more and more recent researches focus on wipe detection directly on compressed video. Wu, Wolf and Liu have proposed a wipe detection based on the DC sequence of MPEG compressed video. But it is only capable to detect horizontal and vertical wipes.

Based on our effective method of abrupt scene change detection, we extend this idea to wipe detection. Taking advantage of the frame-based accuracy of abrupt scene change detection and precise locating capability of scene change positions, the wipe detection can be achieved by accumulating the scene change regions over a period of time. This method requires only macroblock type informaiton and is robust to arbitrary shapes, directions and speeds of wipe sequences. For another type of wipe sequence in which the next scene is moving onto the current one, the number of intra-coded MBs in B and P frames can also perform as the indicator of the wipe sequence effectively. Compared with other proposed methods, this novel method benefits from easy extraction and simple analysis of MB type information. Above all, this proposed method works very effectively no matter where the initial location and in what direction or shape that the next scene wipes out the current one.

CONCLUSIONS

A simple and efficient wipe detection algorithm is proposed using the MB type information. This method benefits from the easy extraction of MB type information, simple analysis, and robustness to arbitrary directions, shapes and foreground or background movement. Frame-based accuracy and the ability to locate the abrupt scene change area can be used to track the motionless wipe transitions by accumulating the scene change MBs. Besides, for the motion wipe detection, the number of intra-coded MBs owing to the ineffectiveness of motion estimation can be used as the indicator. We have also discussed the influence of other effects, different bit rates and different GOP structures, and very satisfactory experimental results can be obtained. Last, we have to emphasize that this method is valid only when B frames are used in the MPEG coding process. As a result, the future work to integrate other methods using motion vectors or DCT coefficients is needed to cope with the sequence containing only I and P frames. Nevertheless, this situation is not common because most video sequence often contains B frames for the purpose of large storage space reduction.

5REFERENCE

[1] Adnan M. Alattar, "Wipe scene change detector for use with video compression algorithms and MPEG-7", IEEE Trans. on Consumer Electronics, Volume: 44 1 , Feb. 1998 , Page(s): 43 –51

[2] W.A.C. Fernando, C.N. Canagarajah, D. R. Bull, "Wipe Scene Change Detection in Video Sequence", ICASP, 1999, pp.294 -298.

[3] Min Wu, Wayne Wolf and Bede Liu, "An Algorithm For Wipe Detection", ICIP, 1998, pp. 893-897.

[4] Stuart J. Golin, "New metric to detect wipes and other gradual transitions in video", SPIE, Vol. 3653, 1998, pp. 1464-1474

[5] Masaru Sugano, Yasuyuki Nakajima, Hiromasa Yanagihara and Akio Yoneyama, "A Fast Scene Change Detection on MPEG Coding Parameter Domain" ICIP, 1998, pp. 888 -892

[6] C.W. Ngo, T. C. Pong and R.T.Chin, "Camera break detection by partitioning of 2D spatio-temporal images in MPEG Domain", Multimedia Computing and Systems, 1999. IEEE International Conference on Volume: 1 , 1999 , Page(s): 750 -755

[7] Soo-Chang Pei and Yu-Zuong Chou, "Efficient MPEG Compressed Video Analysis Using Macroblock Type Information" to appear in IEEE Trans. on Multimedia, Vol. 1, No. 4, December 1999, pp.321-333.

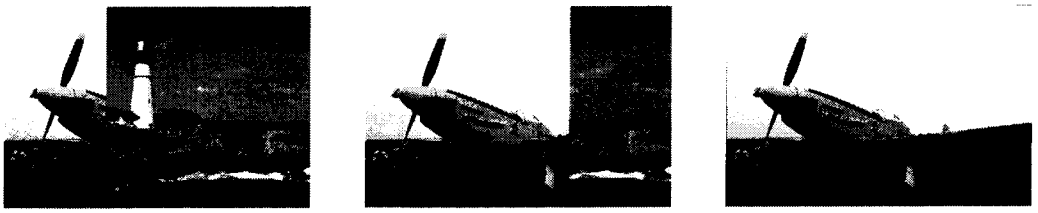


Fig 1: An example of wipe transition from the left to right in rectangular shape.

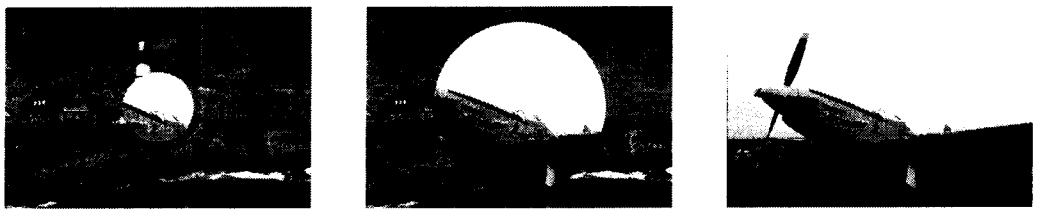


Fig 3: An example of wipe transition from center to spread out in circular shape.

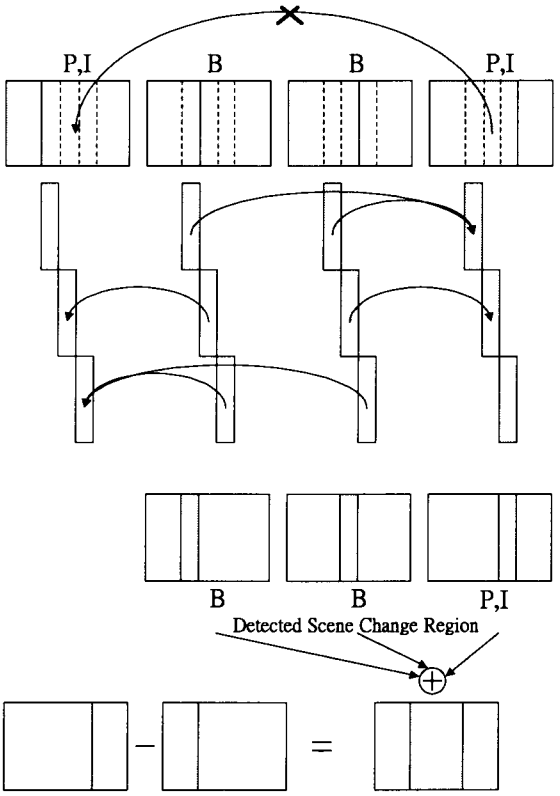
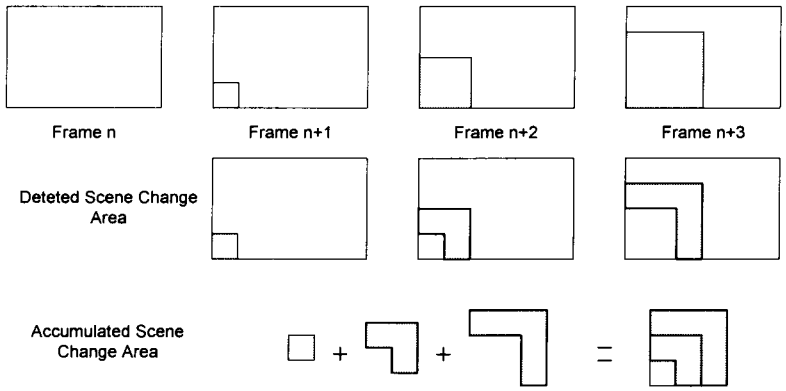
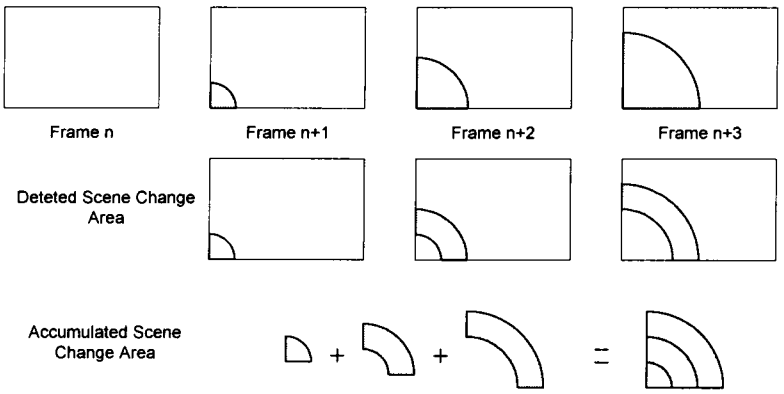


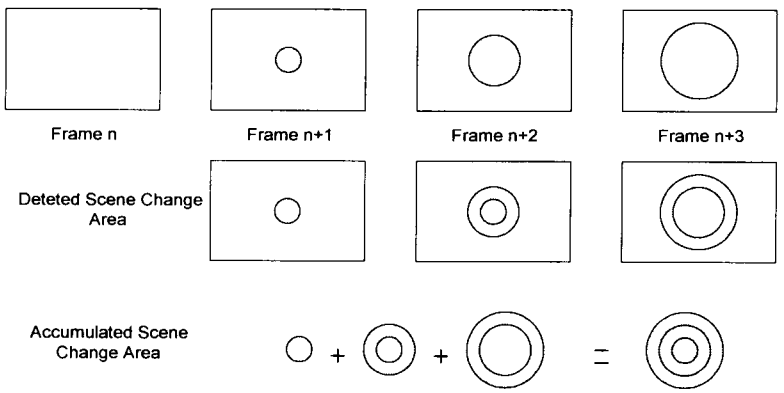
Fig 9: The illustration of the proposed motionless wipe detection method.



(a) Rectangular wipe from bottom-left to top-right



(b) Circular wipe from bottom-left to top-right



(3) Circular wipe from center

Fig 12: The illustration of robustness of motionless wipe detection