모션 속도와 다양한 초기의 중앙점 예측에 기반한 빠른 비디오 모션 추정

팽소호° 뮤잠멜 윤병춘 김덕환*
인하대학교 전자공학과
{pengshaohu, mellore, bchyun@iesl.inha.ac.kr}@iesl.inha.ac.kr, deokhwan@inha.ac.kr*

Fast Motion Estimation Based on Motion Speed and Multiple Initial Center Point Prediction

Shao-Hu Peng°, Khairul Muzzammil Saipullah, Byung-Choon Yun, Deok-Hwan Kim*
Dept. of Electronic Engineering, Inha University

Abstract

This paper proposes a fast motion estimation algorithm based on motion speed and multiple initial center points. The proposed method predicts initial search points by means of the spatio-temporal neighboring motion vectors. A dynamic search pattern based on motion speed and the predicted initial center points is proposed to quickly obtain the motion vector. Due to the usage of the spatio-temporal information and the dynamic search pattern, the proposed method greatly accelerates the search speed while maintaining a good predicted image quality. Experimental results show that the proposed method has a good predicted image quality in terms of PSNR with less search time as compared to the Full Search, New Three-Step Search, and Four-Step Search.

Introduction

Due to the ability of removing temporal redundancies between successive image frames, motion estimation and compensation play key roles in video encoding standards, such as MPEG-2 [1], H.264 [2]. The most popular motion estimation technique is the block matching motion algorithm (BMA), which obtains a motion vector (MV) by separating the current frame into non-overlapping square blocks and searching for the best matching block within a defined search window in the reference frame for each current block.

Full Search (FS) is an optimal block matching algorithm that can find the MV by exhaustively searching all locations inside a defined search window. It is simple and easy to be implemented in hardware. But on the other hand, the large computation of this algorithm makes it difficult to be applied in real-time video compression. To overcome this problem, many efficient fast algorithms have been proposed in the past decades. Some well-known methods are Three-Step Search (TSS) [3], New Three-Step Search (NTSS) [4], Four-Step Search (FSS) [5], etc.

These methods can reduce the computation by only searching some significant points inside the defined search window while maintaining a good error performance. However, these methods fail in taking into account the spatio-temporal dependencies that exist between the MVs. Algorithms that use the spatial or temporal information have been proposed in past years

* 교신저자, 인하대학교 전자공학과
※ 본 논문은 지식경제부 출연금으로 ETRI 스템반도체진흥센터에서 수행한 시스템반도체 융복합형 설계인재양성사업의 연구결과임.

[6] [7] [8] [9]. Recently, H. Nisar et al. [10] proposed a fast motion estimation algorithm based on multiple initial point prediction. The algorithm predicts initial points and constructs a dynamic search pattern for each block by means of the spatio-temporal neighboring MVs.
This paper proposes a new fast motion estimation algorithm based on motion speed and multiple initial center point prediction. The proposed method takes advantage of the spatio-temporal neighboring MVs to determine the initial points similar to [10]. However, unlike [10], a more reasonable strategy is proposed to obtain the initial center points. Moreover, motion speed is estimated by means of the spatio-temporal MVs and thereafter a simple dynamic search pattern is defined to search the MV based on the motion speed and the initial center points. Due to the new strategy of initial center point estimation and the usage of the motion speed, the proposed method achieves fast search speed and good predicted image quality.

Conclusion

A fast motion estimation algorithm based on motion speed and multiple initial center points is proposed in this paper. The proposed method predicts the initial center points and estimates motion speed by means of the directions of the spatio-temporal neighboring motion vectors. According to the predicted initial center points and the motion speed, a dynamic search pattern is then proposed to obtain the motion vector quickly. For slow motion blocks, a small rood search pattern is applied, while for those fast motion blocks, a large rood search pattern following a small rood search pattern is adopted. Due to the new strategy of initial center point prediction and the dynamic search pattern, the proposed method achieves good predicted image quality and speeds up the search process

References

[1] ISO/IEC JTC// SC29/WG11 moving picture experts group, MPEG2 test model 4, 1993.
[2]T.Wiegand, G.Sullivan, A.Luthra, Draft ITU-T recommendation and final draft international standard of joint video specification (ITU-TRec.H.264|ISO/IEC 14496-10 AVC), 2003
[3] T. Koga, K. Iinuma, A. Hirano, Y. Iijima, and T. Ishiguro, “Motion compensated interframe coding for video conferencing,” in Proc. NTC 81, pp.C9.6.1-9.6.5, 1981
[4] R. Li, B. Zeng, M.L. Liou, A new three step search algorithm for block motion estimation, IEEE Trans. Circuits Syst. Video Technol. pp.438-442, 1994
[5] L.M. Po, W.C. Ma, A novel four-step search algorithm for fast block motion estimation, IEEE Trans. Circuits Syst. Video Technol. pp.313-317, 1996
[6]D. Turga, T. Chen, Estimation and mode decision for spatially correlated motion sequences, IEEE Trans. CSVT, pp.1098-1107, 2001
[7] K.R. Namuduri, Motion estimation using spatio-temporal contextual information, IEEE Trans. Circuits Syst. Video Technol. pp.1111-1115, 2004
[8] H. Nisar, T.S. Choi, An adaptive block motion estimation algorithm based on spatio temporal correlation, Digest of Technical Papers, International Conference on Consumer Electronics, pp.393-394, January 2006
[9]H. Nisar, T.S. Choi, Fast motion estimation algorithm based on spatio-temporal correlation and direction of motion vectors, Electron. Lett., pp.1384-1385, 2006
[10] H. Nisar, T. S. Choi, Multiple initial point prediction based search pattern selection for fast motion estimation, Pattern Recognition, pp.475-486, 2009