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A PATH FOR HORIZING YOUR INNOVATIVE WORK

IMPACT OF HEXAGONAL PATTERN SEARCH ON MOTION ESTIMATION

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Abstract

In a video sequence whose content is about the real world, there are two main sources of motion: one is the motion of video objects (men, cars, etc.) and the other is the movement of the camera. The motion of video objects converges in the horizontal, such as people walking and car moving, while the movements of the camera are mainly the translation for tracking the moving objects and the panning which is also in the horizontal direction. In motion estimation, block matching algorithm is in common use, because it is one kind of the simple and effective algorithm for video compression. Block matching algorithm has been adopted by many video compression standards such as MPEG-2, MPEG-4 and H.264.The speedup gain of the HEXBS method over the DS algorithm is more striking for finding large motion vectors a hexagon-based search algorithm that can achieve substantial speed improvement over the diamond search algorithm with similar distortion performance. One of ME techniques, known as Block Matching Algorithm (BMA), has been widely used in various video coding standards. In recent years, many of these BMAs have been developed with similar intention of reducing the computational costs while at the same time maintaining the video signal quality*.*BMA is concerned with estimating the amount of motion on a block by block basis. Hexagon is applied because the block displacement of real-world video sequences is mainly in horizontal and vertical directions [1].

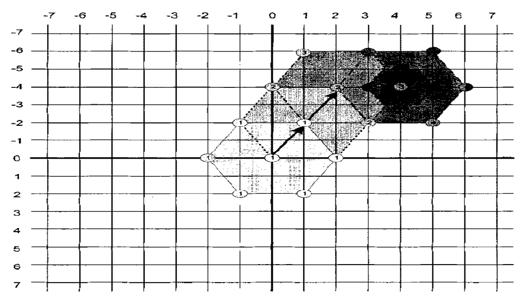
1. INTRODUCTION

The block-based motion estimation (ME) technique has been widely used to eliminate temporal redundancy in current video coding standards such as MPEG-1, MPEG-2, MPEG-4, H.261, H.263 and the emerging H.264/AVC. In between a successive video sequences, there may consists of some stationary objects. ME will determines the movement of object and obtain the motion vectors that can represent the estimated motion. The most straightforward technique is referred to as the full search (FS), which exhaustively evaluates all possible candidate blocks with in the search window. Block-matching motion estimation is vital to many motion compensated video coding techniques/standards, which is aimed to exploit the strong temporal redundancy between successive frames. a circle-shaped search Block-matching algorithm (BMA) is a commonly used technique in video compression for exploiting temporal redundancy between neighboring frames pattern with a uniform distribution of a minimum number of search points is desirableto achieve the fastest search speed.

The most widely referenced block-matching algorithm is probably the full search (FS) algorithm, an algorithm that finds the optimal reference block—the one with the minimum sum-of-absolute-difference (SAD)—by exhaustively evaluating all possible candidate blocks within a search window in the reference frame

The real video sequences usually consist of wide-range motion content and no previously mentioned fast search algorithm can efficiently remove the temporal.

Each search point can be equally utilized with maximum efficiency. It is known that search pattern has an important influence on speed and distortion performance in block motion estimation A hexagon-based search pattern is depicted in Fig. 2(a), which consists of seven checking points.



(c)

Being exhaustive, the FS is computationally intensive, making it unsuitable for many real-time video applications, particularly those using software for video compression It is known that search pattern has an important influence on speed and distortion performance in block motion estimation the DS pattern can find large motion blocks with fewer search points and also reduce its susceptibility to getting stuck in local optima due to its relatively large step size in horizontal and vertical directions these discrepancies in both speed and number of new candidate search points each step result in inconsistent number of search steps or number of search points in different direction search. Ideally, a circle-shaped search pattern with a uniform distribution of a minimum number of search points is desirable to achieve the fastest search speed uniformly. The HEXBS adopts a hexagonal search pattern to achieve faster processing due to fewer search points being evaluated. The motion estimation process normally comprises two steps, namely, the low-resolution coarse search to identify a small area where the best motion vector is expected to lie, and the following fine-resolution inner search to select the best motion vector in the located small region.

The derivation of DS exploits the characteristic

of the center-biased MV distribution typically existed in real-world video sequences and develops two diamond-shaped search patterns The search process of DS starts from the center of the search window using LDSP, and this pattern will be repeatedly used until the center position of LDSP incurs the *minimal matching error* (MME) in any search iteration.DS greatly outperforms other BMAs in terms of search accuracy, efficiency and computational complexity *diamond search* (DS) [3], which is adopted in the MPEG-4 verification model (VM) [4] due to its superiority to the other methods in the same class. However, fixed patterns are unable to constantly match the dynamic motion content and could incur redundant searches It is known that search pattern has an important influence on speed and distortion performance in block motion estimation.

Square-shaped search patterns of different sizes are commonly used in fast motion estimation algorithms. The DS is sensitive to motion vectors in different directions. In other words, these discrepancies in both speed and number of new candidate search points each step result in inconsistent number of search steps or number of search points in different direction search

Hexagonal Pattern Search

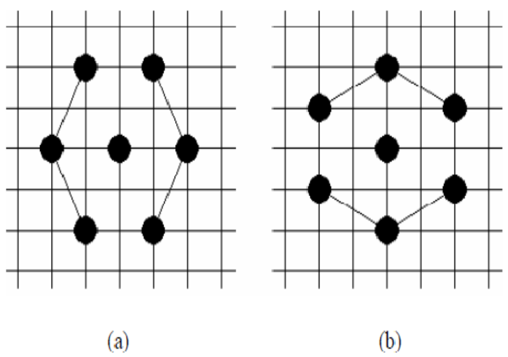


Fig. 2. The horizontal hexagonal search pattern (a) and the vertical hexagonal search pattern (b).

The hexagonal search pattern used in [5] the horizontal hexagonal search pattern (Fig. 2a). Obviously, there should exist another type of hexagonal search pattern, the vertical hexagonal search pattern (Fig. 2b), which can also be used in HEXBS. The fast BMAs using the horizontal and vertical hexagonal search patterns are named h-HEXBS and v-HEXBS here respectively. Their performances are compared in six aspects: 1) mean absolute distortion (MAD); 2) mean square error (MSE); 3) the number of search points (NSP) for each block; 4) peak signal noise ratio (PSNR) of the compensated frame; 5) the distance from the true motion vectors (MVs) (obtained by FS); and 6) the probability of finding the true MVs (they are all the average values over all frames in the sequence) for a “salesman” sequence (352×288, 449 frames) and a “garden” sequence (352×240, 115 frames). Hexagon-Based Search (HEXBS) [4] which are extremelyfast search algorithms, but give worse image quality than full search.

DS and HEXBS may find satisfactory enough motion vectors if the motion between successive frames are very small. However, for fast moving objects, they find motion vectors which give a locally minimum block distortion due to the sequential nature of these algorithms.

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