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A NOVEL FAST BLOCK-MATCHING ALGORITHM FOR MOTION ESTIMATION USING ADAPTIVELY ASYMMETRIC PATTERNS

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Abstract. *This paper proposes a novel fast block-matching algorithm (BMA) designated as Adaptive Asymmetric Pattern Search (AAPS) for motion estimation (ME) in the compression of MPEG-4 video data. In contrast to existing BMAs, the proposed algorithm uses an asymmetrical search pattern and a predicted motion vector in the initial search step, and then dynamically adjusts the size of the search pattern throughout the remainder of the search procedure in order to minimize the total number of search points required. The performance of the AAPS algorithm is evaluated using an MPEG-4 encoding platform. The experimental results show that compared to the diamond search algorithm and the adaptive rood pattern search algorithm, AAPS improves the search speed by 56∼65% and 20%, respectively, while simultaneously maintaining a high peak-signal-to-noise ratio.*

Keywords: Motion estimation, Fast block-matching algorithm, Adaptive asymmetric pattern search (AAPS), Adaptive asymmetric pattern (AAP), Dynamically-adaptive rood pattern (DARP)

1. **Introduction.** Video compression is an essential task in video-on-internet applications due to the limited availability of channel bandwidth and storage space. In compressing video data, an essential concern is to eliminate temporal redundancy between successive frames in the video sequence. Due to its efficacy and straightforward implementation, this is generally achieved using the Block-Matching Motion Estimation (BMME) algorithm. BMME algorithms are widely adopted in many video coding standards, including ISO MPEG-1 [1], MPEG-2 [2], MPEG-4 [3], ITU-T H.261 [4], H.262 and H.263 [5]. One of the most computationally straightforward block-matching algorithms (BMAs) is the full search (FS) algorithm [6,7], designed to locate the optimal solution within a search window. However, FS requires the processing of an enormous volume of data, and hence the motion estimation task tends to limit the overall performance of the video coding process.

To address this problem, researchers have proposed a number of faster BMAs in recent decades. The three-step search (TSS) algorithm presented by Koga *et al.* [8] is a typical example of one such algorithm. Block matching in TSS generally requires just 25 search points, and therefore represents a considerable improvement upon the FS algorithm. However, the initial search pattern is large and diffuse. Consequently, the search path may be led in an inappropriate direction, with the result that the potential improvement in the motion estimation performance is lost. To resolve this problem, a new three-step search (NTSS) method was proposed based upon a center-biased search pattern [9]. Compared to the original TSS algorithm, NTSS improved both the speed and the precision of the search process, and was therefore used as the basis for many subsequent BMAs. For