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COARSE-TO-FINE PARTIAL DISTORTION SEARCH ALGORITHM FOR MOTION ESTIMATION

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Abstract. *This study proposes a coarse-to-fine partial distortion search algorithm for motion estimation to accurately predict the minimum distortion region. In the proposed method, the distortion behavior is first analyzed in a search window to indicate the possible occurrence region of the global minimum distortion position. Normalized partial distortion searching is then performed on the selected region, instead of the whole search window. The proposed algorithms have a low computational complexity yet do not degrade the PSNR significantly.*

Keywords: Normalized partial distortion search, Motion estimation, Block-matching distortion, Full search, Sum of absolute difference

1. **Introduction.** Many video coding standards, such as H.26X [1,2] and MPEG-X [3,4] have been proposed for various applications [5]. These coding standards adopt motion estimation to remove the temporal redundancy of the interframes. The block-matching algorithm (BMA) is widely used to find motion vectors (MV) [6]. The most straightforward BMA is the full search (FS) algorithm, which matches all possible blocks within the restricted search area, called the search window, in the previous frame to find the block with the minimum block-matching distortion (BMD) defined as the sum of absolution difference (SAD). However, the FS algorithm requires massive computations to calculate the BMD, and is thus unsuitable for real-time implementation.

Motion estimation is the key component of video coding. Fast and accurate motion estimation method is highly desired to achieve high compression ratio while maintaining good reconstructed visual quality. Except for video coding, efficient methods to estimate motion include fields as divers as remote sensing, virtual reality, and content-based representation. Moreover, in the practical implement, motion estimation also can be used to GPS positioning [7] to predict the object displacement accurately and be employed to the trajectory tracking for robot manipulators [8]. The key step to the success of the aforementioned tasks is the estimation of motion.

Many fast search algorithms have been proposed to reduce the computations of BMD. The algorithms can be roughly classified into two groups, search point reduction and calculation reduction of SAD. Search point reduction involves decreasing the number of search points within a search window [9-11]. The diamond search (DS) algorithm is a typical search point reduction method [12]. The DS algorithm uses two diamond patterns and unrestricted searching steps to find the minimum distortion block. The pattern-based motion estimation algorithm has many other variations [13,14]. These algorithms indeed significantly reduce the computational complexity of motion estimation by assuming that