

Chapter 12

Fast HEVC Inter–Prediction Algorithm Based on Matching Block Features

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ABSTRACT

A fast inter-prediction algorithm based on matching block features is proposed in this article. The position of the matching block of the current CU in the previous frame is found by the motion vector estimated by the corresponding located CU in the previous frame. Then, a weighted motion vector computation method is presented to compute the motion vector of the matching block of the current CU according to the motions of the PUs the matching block covers. A binary decision tree is built to decide the CU depths and PU mode for the current CU. Four training features are drawn from the characteristics of the CUs and PUs the matching block covers. Simulation results show that the proposed algorithm achieves average 1.1% BD-rate saving, 14.5% coding time saving and 0.01-0.03 dB improvement in peak signal-to-noise ratio (PSNR), compared to the present fast inter-prediction algorithm in HEVC.

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INTRODUCTION

High Efficiency Video Coding (HEVC) (Prouazad, Dpitre, Azimi, & Nasiopoulos, 2012; Sullivan, Ohm, & WooJin, 2012; Nightngale, Wang, & Grecos, 2012) is the newest international video compression coding standard, which is being developed by the by the ITU-T and ISO/IEC MPEG. The destination of HEVC is to achieve a video compression ratio as twice as that of the H.264/AVC standard. Up to now, this goal is achieved especially for the HD video, for which HEVC has more coding efficiency than H.264/AVC.

However, HEVC has brought about more coding computational complexity than H.264/AVC. In order to reduce the computational complexity, several algorithms about fast inter-prediction were proposed. For video compression, the fast inter-prediction often include the following methods: spatial continuity of the motion field (Shen, Liu, Zhang, & Shi, 2008; Shen, Liu, An, Ma, & Zhang, 2010; Shen, Liu, An, Ma, & Zhang, 2012), skip mode decision (Grecos, Yang, 2006; Yu, Martin, & Park, 2008), hierarchical structure of complexity of the search process (Liu, Shen, & Zhang, 2009), directional motion homogeneity measures (Zhao, Wang, Kwong, & Kuo, 2010), phase correlation information (Paul, Lin, Lau, & Lee, 2011), and Fuzzy reasoning technology (Lee & Shin, 2009; Lee, Kuo, Huang, & Chang, 2011). For inter-prediction in HEVC, there are several fast algorithms proposed by researchers in video compression coding. Corrêa (Lee, Kuo, Huang, & Chang, 2011) proposed a complexity control method based on a decision algorithm. Kim (Kim, Jeong, Cho, & Choi, 2012) proposed an adaptive coding unit early termination algorithm for HEVC. Kim (Kim, Yang, Won, & Jeon, 2012) proposed an SKIP mode early detection algorithm in one CU level. Shen (Shen, Yu, & Chen, 2012) employed important and computational-friendly features to avoid exhaustive RDO search on all possible CU sizes and its modes. They (Shen & Yu, 2013) also proposed a CU splitting early termination algorithm. Corrêa (Corrêa, Assuncao, da Silva Cruz, & Agostini, 2012) proposed an algorithm that maintaining the maximum coding tree depth for a relatively long period and skipping all the remaining tree. Choi (Choi & Jang, 2012) proposed an early TU decision method for HEVC, which can prune a residual quadtree in the early stages. In (Correa, Assuncao, Agostini, & da Silva Cruz, 2013), a complexity control method for HEVC was proposed by dynamically adjusting quadtree-based data structures depth. In (Zhang, Wang, & Li, 2013), based on the depth information correlation between spatio-temporal adjacent CTUs and the current CTU, some depths can be adaptively excluded from the depth search process in advance. Goswami (2015) developed a statistical model to predict an early skip for the current CU based on correlation between skip modes in both the temporal and spatial domains. Shen (Shen, Liu, Zhang, Zhao, & Zhang, 2015) proposed an effective CU size decision method for HEVC based on the spatial and temporal correlations. Wang et al. (2015) proposed an Early detection of all-zero 4×4 blocks in HEVC according to the DCT coefficients. Vanne (2014) proposed an efficient mode decision scheme by incorporating the following three technologies: 1) SMP modes; 2) range limitations primarily in the SMP sizes and secondarily in the AMP sizes; and 3) a function of the quantization parameter. Shen (Shen, Zhang, & Liu, 2014) proposed a fast inter-mode decision algorithm for HEVC by jointly using the inter-level correlation of quadtree structure and the spatiotemporal correlation. Pan (2014) proposed an early MERGE mode decision algorithm to reduce the computational complexity of the HEVC encoder. In our previous works (Zhong, He, Qing, & Li, 2013; Zhong, He, Qing, & Li, 2015), the spatial correlation between two neighbor depths of CUs and the temporal correlation between two adjacent frames are utilized to reduce the CU depths and partition modes, further reducing the coding computational complexity.

Despite distinct coding time is saved in Ref. (Zhong, He, Qing, & Li, 2015), a little bitrate increment has been caused by the PU modes decision error brought by the temporal correlation between two

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