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Performance evaluation of a new efficient H.264 intraprediction scheme

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Abstract: The paper presents a new efficient H.264/AVC4 × 4 intraprediction scheme. The new prediction scheme is based on the best prediction matrix mode. The main idea behind the new prediction scheme is to combine the most usable intraprediction modes, {vertical - horizontal - DC} , into a new efficient prediction mode. The new prediction scheme is implemented using VHDL and hence it uses the full advantages of inherent parallelism in the hardware. We evaluate the performance of this prediction scheme in terms of compression ratio, peak signal to noise ratio, and bit rate using seven video sequences. Moreover, we analyze the power consumption, the delay, and FPGA area utilization of the implemented H.264 encoder after utilizing the new prediction scheme. The performance measures as well as the area and power consumption are compared to other best known prediction algorithms.

Key words: Audio video coding, H.264, intraprediction, field programmable gate arrays, compression efficiency

1. Introduction

Video compression systems are used in many commercial products, from consumer electronic devices such as digital camcorders and cellular phones to video teleconferencing systems. These applications make video compression hardware devices an inevitable part of many commercial products. In order to improve the performance of the existing applications, an international standard for video compression, which is named H.264 or MPEG4 Part-10, was developed. This standard significantly improves video compression efficiency [1]. Figure 1 illustrates the main building blocks of the H.264 encoder. It is clear from the block diagram that the video compression efficiency of the H.264 standard is not a result of a single feature, but a combination of a number of encoding subblocks. One of the most important factors of the improved compression efficiency of the H.264 is its intraprediction algorithm [1,2]. The intraprediction algorithm generates a prediction for a macroblock (MB) based on spatial redundancy. The H.264 intraprediction algorithm achieves better coding results than the intraprediction algorithms used in previous video compression standards [2,3].

There are nine prediction modes available for the 4×4 luminance (luma in short) block as shown in Table 1, four modes for the 16×16 luma MB, and four modes for the 8×8 chrominance (chroma in short) blocks to remove spatial redundancy within a frame. The prediction mode for each block that results in minimum difference between macroblock P and the current block is selected. The first three prediction modes (vertical, horizontal, and DC) that are used for encoding intra 4×4 blocks are the most commonly used; collectively they cover 85%–95% of the best modes [4].

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