訂　正　確　認　報　告　書

訂正承認日	2018年9月18日	訂正申請日	2018年9月18日
題名	**Research Architecture Design for Ultra High Definition Video Encoding**		
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本論文は、学位規則第23条第1項に照らし、学位の取消には該当しないが、訂正を要する箇所が認められたため、これに対して著者によりなされた訂正について確認した結果を以下の通り報告する。

1. 訂正箇所と訂正内容

(1) 訂正箇所: line 1-3, 6-11 in page Ⅰ and line 1-3, line6-11 in page 1

訂正内容：記述の訂正

具体的内容：

~~Ultra high definition (UHD) video includes 4K (3840×2160) and 8K (7680×4320, also known as super Hi-vision) formats. By delivering 4 and 16 times of pixels per frame compared to today's high definition (1920x1080), UHD videos offers remarkably enhanced visual experience and provides rich cues for stereoscopic feeling such as visual field angle, linear perspective, and texture gradient. The UHD is currently being promoted in the next-generation standard of digital television.~~

~~To store and transmit the huge volume of UHD video data, efficient and real-time compression is essential. The latest video coding standards such as H.264/AVC and H.265/HEVC provide excellent compression ratio. However, the key compression algorithms, such as intra prediction and fractional motion estimation (FME), involve high computational complexity.~~

Compared with high definition (HD, 1920x1080) video, ultra high definition (UHD) could provide much better visual experience. It contains two resolutions: 4K (3840x2160) and 8K (7680x4320, also known as super Hi-vision), which are 4 and 16 times of pixels per frame of HD video. UHD will be used as the future standard in the digital television.

Due to the huge data of UHD video, the storage and transmission will be great challenges and therefore the real-time efficient video compression is necessary. H.264/AVC and H.265/HEVC are the latest video coding standards. Although they could offer efficient compression performance, while the implementations of them takes very high computational complexity, due to many involved complex coding tools, for example, the intra prediction and fractional motion estimation (FME).

(2) 訂正箇所: line 1-8 in page 8

訂正内容：記述の訂正

具体的内容：

~~H.264/AVC is the video coding standard developed jointly by ITU-T and ISO/IEC [1]. It has been adopted as the major coding standard due to its excellent coding efficiency. New coding techniques such as variable block size motion compensation, simplified transform, multiple reference frame and context adaptive entropy coding are introduced to increase the coding efficiency. A new intra-frame prediction technique is also introduced to use neighboring pixel values to predict currently coding block. H.264/AVC intra-frame encoding compresses video data by exploiting spatial redundancy and delivers better coding performance compared with JPEG2000.~~

Due to the excellent video coding efficiency, the H.264/AVC coding standard which is developed jointly by ITU-T and ISO/IEC [1] is now widely adopted in industry. A lot of coding techniques are involved to improve the coding efficiency, such as intra prediction, multiple reference frame, variable block size, and context adaptive binary entropy coding. For the intra frame coding, H.264/AVC outperforms the famous picture coding standard JPEG 2000.

(3) 訂正箇所: line 16−18 in page 8, line 1-4 in page 9

訂正内容：記述の訂正

具体的内容：

~~Besides, pre-filtering process on the boundary reference pixels is performed for the next prediction operation. It should be noticed that the transform of intra 8x8 prediction must use the new 8x8 integer Discrete Cosine Transform (DCT) addressed by high profile. This new intra coding tool can make I-frame coding more efficiently.~~

~~**2.1.2 Intra Prediction Encoding Analysis**~~

~~Figure 1 shows the H.264/AVC intra-frame encoding flow. First, intra prediction unit refers to neighboring reconstructed pixels to generate each prediction mode pixels. Mode decision unit chooses the best mode and outputs its prediction values.~~

Meanwhile, the boundary reference pixels are pre-filtered before the next prediction. Furthermore, the 8x8 integer Discrete Cosine Transform (DCT) is adopted for the 8x8 intra prediction. The coding efficiency of the intra frame coding is further improved with these coding tools [4][22].

2.1.2 Intra Prediction Encoding Analysis

Figure 1 illustrates the processing flow of the H.264/AVC intra frame encoding. Firstly, referring the neighboring reconstructed pixels, the intra prediction unit generates the predicted pixels of the current block for all modes. The best mode is chosen by the mode decision unit.

(4) 訂正箇所: line 13-14 in page 29

訂正内容：記述の訂正

具体的内容：

~~This intra-frame encoder is appropriate for the applications like digital video recorder and digital camera that do not need or cannot afford the inter prediction capability because of the low power and cost.~~

This intra-frame encoder is suitable for some portable consumer electronics which cannot afford the complex motion estimation due to the low power and hardware cost [24].

(5) 訂正箇所: line 5-13 in page 65

訂正内容：記述の訂正

具体的内容：

~~High Efficiency Video Coding (HEVC) is a draft standard under development by Joint Collaborative Team on Video Coding (JCT-VC). It is aimed at 50% bit rate reduction relative to H.264. To improve the efficiency of HEVC intra coding, many new features are proposed, with two major differences from H.264. One is that the number of prediction block types in HEVC intra prediction can be at least 5 (from 64x64 down to 4x4), while the corresponding number for H.264 is only 3 (from 16x16 to 4x4). The other is that up to 34 angular prediction modes are defined in HEVC, much more than only 9 in H.264. These features results in significantly higher complexity for intra prediction.~~

Recently, a new video coding standard is announced as High Efficiency Video Coding (HEVC), which is developed by Joint Collaborative Team on Video Coding (JCT-VC). It almost achieves double compression performance of H.264. During the intra coding process, two new coding tools are involved. One is so called quard-tree block coding which allows the intra prediction is processed based on the blocks from 64x64 to 4x4. The other is the highly increased numbers of the prediction modes including 34 angular and 1 DC. Compared with H.264, due to these new coding tools, the complexity of intra prediction becomes much higher [44].

2. 訂正理由

他者の論文からの不適切な引用が認められたため訂正させた。具体的には、(1) は第一著者でない共著論文から、(2) - (5) は他の論文からの不適切な引用であった。とくに、(4) に関しては、訂正と同時に参考とした文献(参考文献に既出)の番号を追加させた。

3. 訂正を認めた理由

訂正箇所はいずれも導入部であり、本博士論文の根幹を成す研究成果に影響を与えないため、本訂正は妥当と判断する。