XGI TECHNOLOGY WHITEPAPER

Cipher™ Video Processor

XGI Technology Inc.
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Cipher™ Video Processor

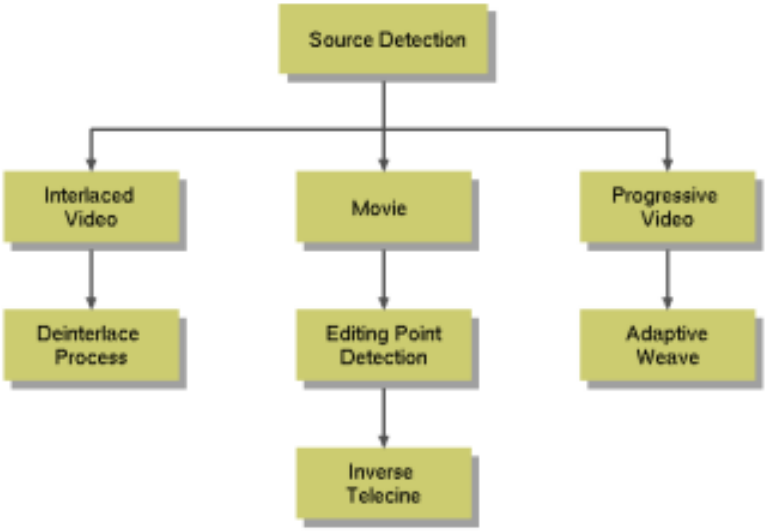
Introduction

The function of the digital video processing in Volari graphics processor is to process the input video signals before it was being playback and displayed on the computer monitor. This video processing core implemented a number of proprietary video processing techniques to provide the best possible playback quality. The playback quality of Volari graphics processor is designed to be comparable to those high-end DVD players on the market.

Video Processing Core of Volari GPU

There are three categories of video sources in applications, namely interlaced vide source, movie source, and progressive video source. Before playback a video source and display it, a video source has to be applied with a specific processing that is only suitable for that category of video source. If an incorrect processing is applied, the playback quality might be devastating.

The following diagram illustrates the block diagram of the video processing core in Volari graphics processor. The detail explanations are discussed in the following subsections.

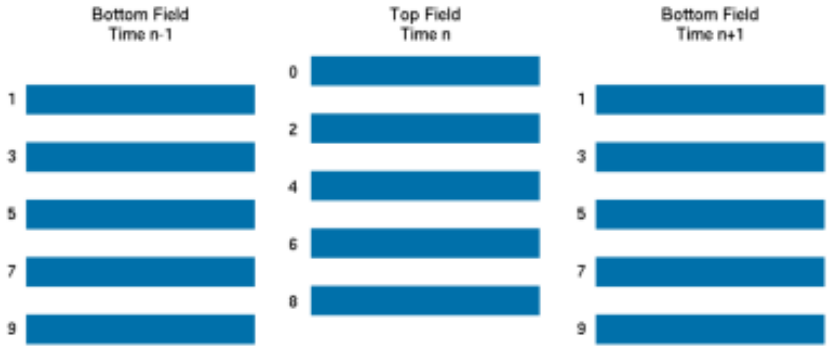


Source Detection

Since there are three categories of input video sources, it is important to identify the input video type in order to apply an appropriate processing technique to the video source. The video processing core of Volari graphic processor has implemented a proprietary video source detection algorithm that identifies the distinctive characteristics of the input video source. Therefore, based on the distinctive characteristics, the processing core can then classifies the input video source accurately.

Interlace Video

The interlaced video signal was the signal for the television and originated for the efficiency of transmission channels. At a time instance, the interlaced video signal contains only a half of the entire vertical resolution, such as shown in the diagram below. Therefore, the majority of televisions on the market were designed to play the interlaced video source. However, the computer monitor, on the other hand, accepts only the frame-base (progressive) signals hence the field-base interlaced video source needs to be convert to the frame-based signals before it could be shown on the computer monitor. This video format conversion is often called as **de-interlacing** process.



Two commonly used methods for the de-interlacing process are Bob and Weave. The Bob process is to interpolate the missing video scan lines by using the information in a video field to form a video frame. While, the Weave process is to merge the top field at time n with the bottom field at time n-1 or n+1 to form a video frame. These two processes are easy to implement but generate de-interlaced video frames of marginal quality.

In Volari graphics processor, the video processing core implements a proprietary de-interlace algorithm that provides a superior quality for playing back the interlaced video signals on the computer monitor. This de-interlace process performs a pixel-based processing that determines each pixel motion information to reconstruct each pixel with the technique corresponding to the motion information. Furthermore, the video processing core implements a proprietary edge interpolation technique that dramatically improves the smoothness of object edges in video frames generated.

The three images on the next page shows the result comparison of three de-interlace techniques. The picture at the top is reconstructed by the video processing core of Volari GPU. The picture at the middle is reconstructed using a vertical interpolation method. The picture at the bottom is reconstructed by the Weave process. It is clear to see that the Volari's pixel-based algorithm gives the best reconstructing quality.

Original

Verticle Interpolation

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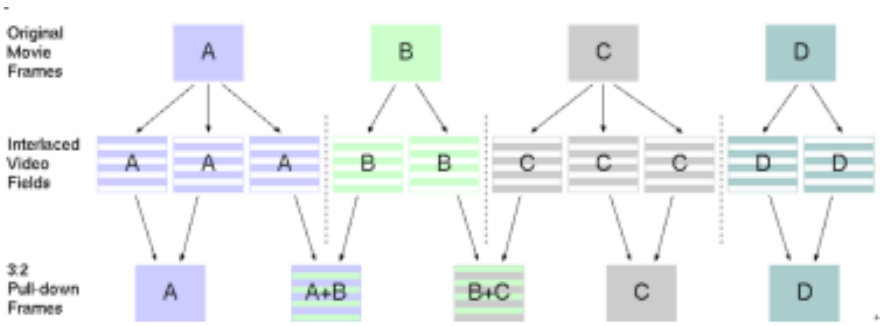
Voalri's Proprietary Pixel-based interpolation

Movie

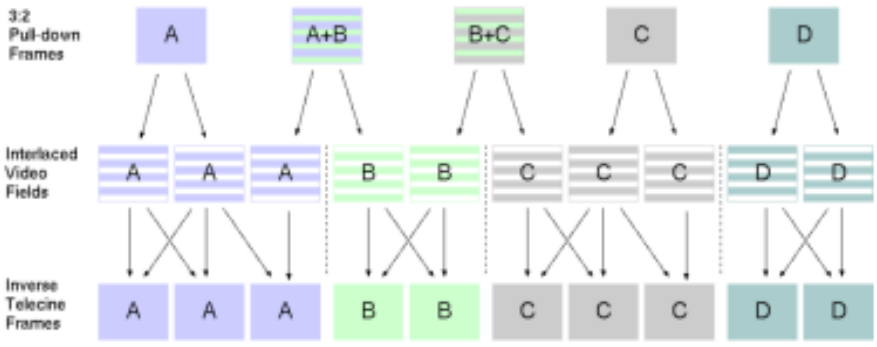
The movie source is commonly seen in DVD titles. The frame rate of a movie source is 24 frames per second. Therefore, to play a movie source on the 60 fields per second NTSC TV system the movie frame rate needs to be converted from 24 frames per second to 60 fields per second and is stored as 30 frames per second in DVDs. This frame rate conversion is often called as 3:2 pull-down processes.

The following diagram shows an example of the 3:2 pull-down process applied to a movie segment of four frames. In this case, the original movie frames are separated into three interlaced fields like frame A and C or into two interlaced fields like frame B and D. Therefore, the frame rate is converted from 24 frames per second to 60 fields per second. Then, the interlaced fields are merged into 3:2 pull-down frames giving a frame rate of 30 frames per second.



3:2 Pulldown Process

However, to playback a 3:2 pull-down movie source on the progressive scan monitor, the movie source needs to be converted to a progressive frame sequence. This process is called inverse telecine. The following diagram shows an example of the inverse telecine process. In this example, the interlaced frames are separated into interlaced fields. The corresponding interlaced fields are then merged to recover the original film frames. For maintaining 60 frames per second, the recovered movie frames are duplicated according to the 3:2 pull-down order.



Inverse Telecine

Nevertheless, this 3:2 pull-down sequence might be interfered by the movie editing process. A good movie editing process can maintain the 3:2 pull-down sequence so that the move source can be correctly played back on the computer monitor by the inverse telecine process. On the other hand, a bad movie editing process would destroy the 3:2 pull-down sequence and the inverse telecine process would not be able to produce correct movie frames to be shown on the computer monitor.

Therefore, the video processing core of Volari graphics chip implements a proprietary 3:2 pull-down editing point detection technique to simultaneously monitor the editing points in a movie sequence. When a bad editing point in a movie sequence is detected, the video processing core will act instantly to correct the inverse telecine results and provides the best movie playback quality.

Progressive Video

The progressive video source is not as widely seen as the interlaced video source and movie source. On example of the applications of progressive video sequences is for animations. Since the progressive video matches the displaying format of the computer monitor, the progressive video source can be played back on the computer monitor directly by merging two consecutive interlaced fields into a progressive frame. However, the progressive video stored in a storage media may be in progressive format or in interlaced format shifted by one field, such as shown on the left.

Progressive Video Sequence

Therefore, the video processing core of Volari graphics chip implements a proprietary adaptive Weave process to accurately play back the progressive video source on the computer monitor. That is, the processing core first detect whether the progressive video sequence is in the standard format or in the format shifted by one field, and then weave two corresponding fields to form a progressive frame before showing it on the monitor. As we can see that Volari correctly recognizes the progressiveness of the input frame and outputs it as a progressive frame using the adaptive Weave process. On the other hand, a graphics chip without the source detection functionality cannot classify the video frame as a progressive frame and applies the de-interlace process to the progressive. As a result, the quality of the de-interlaced