

**Committee T1
Contribution**

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STANDARDS PROJECT: Visual Channel Delay
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TITLE: Field Vs. Frame Calculations for Visual Channel Delay
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SOURCE: NTIA/ITS

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ABSTRACT: This contribution recommends that calculations of visual channel delay be based on fields rather than frames for an interlaced video system such as NTSC. Using fields rather than frames will double the resolution of the measurement without significantly increasing the complexity and will overcome certain measurement anomalies that might result from calculations based on frames.
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Introduction

In 1993, NTIA submitted contribution T1A1.5/93-60 which contained a robust method for calculating the average delay of a video stream to within one field of accuracy ($1/60^{\text{th}}$ of a second). This method used a novel interleaved field-differencing technique to sample the scene motion of an NTSC video stream 60 times per second. These scene motion waveforms, extracted from the input and output video streams, were then cross-correlated to yield video delay measurements. Although this measurement technique was designed for constant video delay systems, it demonstrated that in-service, low complexity, field accurate video delay measurements are possible with NTSC systems.

This contribution recommends that calculations of visual channel delay be based on fields rather than frames for an interlaced video system such as NTSC. Using fields rather than frames will double the resolution of the measurement, permitting video delays to be calculated to within $1/60^{\text{th}}$ of a second without significantly adding to the complexity of the measurement. In addition, it will be shown that calculations based on fields can overcome certain measurement anomalies that can result from calculations based on frames.

Measurement Issues

Figure 1 illustrates a type of input to output video field mapping that has been observed in output video streams from low bit-rate video codecs. In this particular case, the video codec is only coding one field out of every four and is shifting the NTSC video framing by one field (i.e., NTSC fields that were field 1 on the input end up appearing first as field 2 on the output or visa versa). Exactly why low bit rate codecs do not preserve the original NTSC framing is unclear. It may be due to the coder stripping off the required synch information and not transmitting this information to the decoder. The important point to note is that an output frame can contain fields from two different input frames. In Figure 1, output frame 3 contains fields from input frames 1 and 3. In general, both the fields that are dropped and the resulting NTSC framing of the output video stream are time varying.

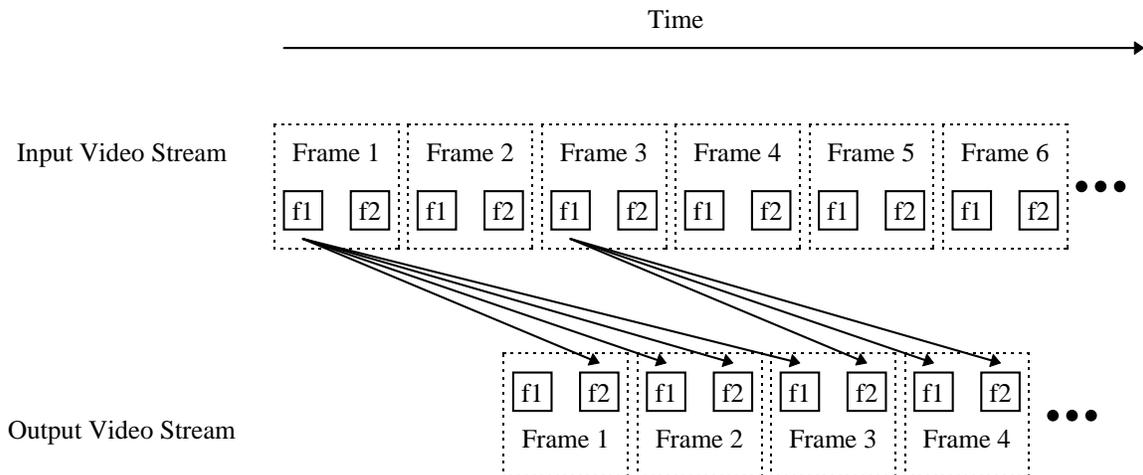


Figure 1 Example input to output mapping of video fields

In the example in Figure 1, comparing output frame 3 with the input video frames using a mean square error matching will produce two dips in the mean square error, one for input frame 1 and the other for input frame 3. To resolve this ambiguity, it is necessary to use field processing, rather than frame processing. In other words, the video delay of each new output field (rather than frame) should be computed by comparing the output field with earlier input fields. Mean square error matching of an output field does not use any more calculations than mean square error matching of an output frame (fields contain half as many pixels as frames but there are twice as many of them). Besides the above advantages, it is clear that field processing will yield visual channel delay estimates with twice the resolution (i.e., $1/60^{\text{th}}$ of a second instead of $1/30^{\text{th}}$ of a second).

Conclusion

This contribution has recommended that field processing rather than frame processing be used for the visual channel delay standard if the video system being tested is an interlaced system such as NTSC. This approach has a number of advantages, including greater resolution and the ability to resolve ambiguities that might result if frame processing were used. If Working Group T1A1.5 is agreeable to this recommendation, “frame” terminology and algorithms should be replaced with “field” terminology and algorithms.