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How to: Objectively Scoring Your Video

Video Clarity, Inc.

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ClearView has the ability objective score the video quality, graph the result, and show you why. This note shows how to do this step-by-step.

Background

ClearView imports files and records from hardware sources. These video sequences are decoded and stored as completely uncompressed video frames in 4:2:2 Y'CbCr or 4:4:4 RGB space. Since the video sequences are completely uncompressed, any compressed video standard can be compared to another compressed video standard.

Before performing any objective measurement, the video sequences must be completely aligned. To do this, please refer to our Align Video Sequences application note.

Example

The video sequence on the left is the 1280x720P, PAL source. It was imported as an Y'CbCr uncompressed file directly into ClearView. ClearView then exported this video as a raw AVI file, which was imported in TMPGEnc (a software encoder), which compressed the video as motion JPEG 2000 video at 200Mbps wrapped in QuickTime and MPEG-2 video at 20Mbps wrapped in MPEG-2 TS.

These compressed files were then inputted into ClearView by dropping the video sequences onto the desktop and pressing load. To read more about how to import files into ClearView, please refer to our Import a File application note.

Figure 1: Side-by-side Mode mJPEG2000 at 200Mbps (Source on Right)

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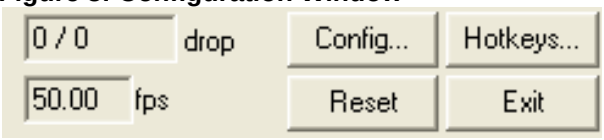
Figure 2: Side-by-Side MPEG-2 at 20Mbps (Source on Right)

In general both video sequences look quite good. The mJPEG version is somewhat clearer, but the file size is 10x larger.

Any of the Objective Metrics can be run at this point, as an example; this paper will run the JND (Sarnoff's Just Noticeable Differences) metric. All of our objective metrics work the same way.

Since these video sequences are progressive, the score should be calculated per frame and then averaged. Using JND, ClearView provides many configurable options, which can be left at the default. For completeness, we will briefly discuss the configuration menu which is accessed from the Hotkey pane as seen below.

Figure 3: Configuration Window



Pressing config brings up the ClearView Configuration menu as see below.

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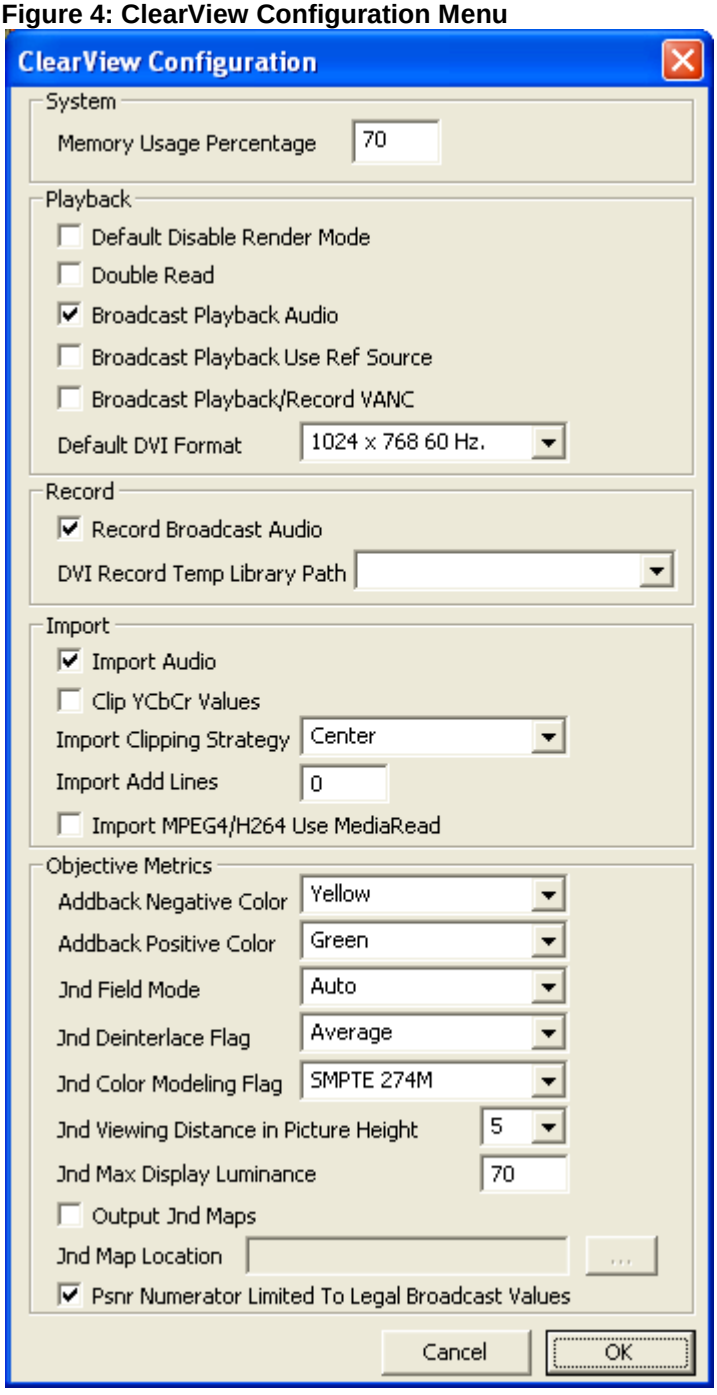
Figure 4: ClearView Configuration Menu



Under Objective Metrics, ClearView includes 9 configurable options:

1. Addback Negative Color: in A-B Addback mode, if the video image on the right is greater than the video image on the left by the threshold, then this color will be displayed instead of the video sequence on the left.
2. Addback Positive Color: in A-B Addback mode, if the video image on the left is greater than the video image on the right by the threshold, then this color will be displayed instead of the video sequence on the left.

3. JND field mode should be set to auto, which allows ClearView to decide based on the video format. For interlaced content, it will automatically choose field. For progressive content, it will choose frame.
4. JND de-interlace flag is only important if running interlaced content in frame mode.
5. JND color modeling flag is based on the color space automatically. This is an override.
6. JND viewing distance in picture heights is set to 2 for expert mode based on T1.TR.75.2001 the ATIS/ANSI specification for Objective Perceptual Video Quality Measurements or 5 for standard mode. The number is how far away the subjective viewer is instructed to stand relative to the height of the display.
7. JND max display luminance is the brightness of the display. Normally, this is set to 70 per itu-rec p.910.
8. Output JND maps/JND map location drops the video differences as seen by the JND algorithm so that you can judge how JND scored the video sequences.

At this point, ClearView can calculate the objective video score using Sarnoff JND. By checking the JND full reference tab, we can control the JND measurement. On the top row, turn JND on, Chroma on, which calculates both Luma and Chroma components, and spatial alignment off. The score will be measured while the video sequences are playing. To view a graph of the result, press graph. To log the results, press log. The log file can be imported into Microsoft excel using the cvgraph tool, which is a command line process (from the windows cmd window, type cvgraph <logFileName> without the extension).

Figure 5: Objective Video Score mJEG2000

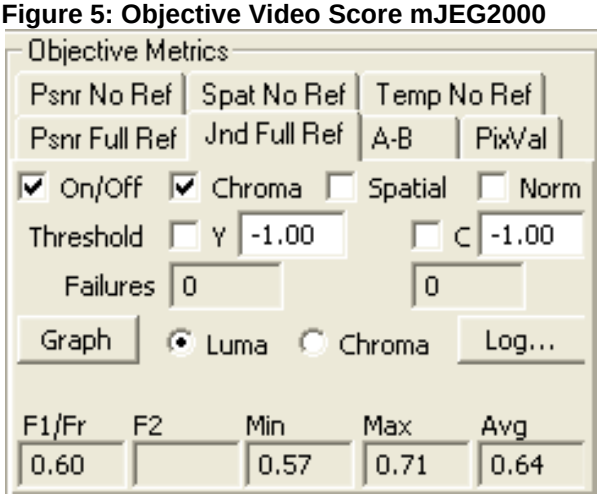


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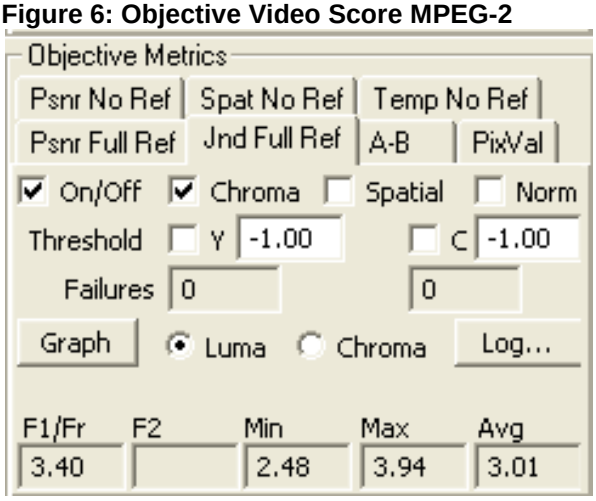
Figure 6: Objective Video Score MPEG-2



The graphs look like the following. Three things should be noticeable from the following graphs:

- the scale is different
- the 'J' indicates that this graph is JND
- the data is plotted over time in green, which indicates the Y/Luma component

Figure 7: mJPEG2000 JND over time

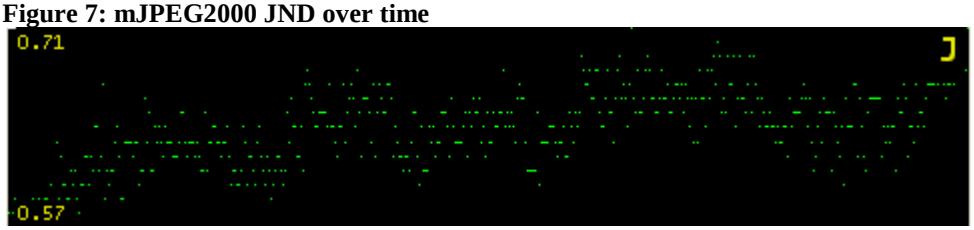
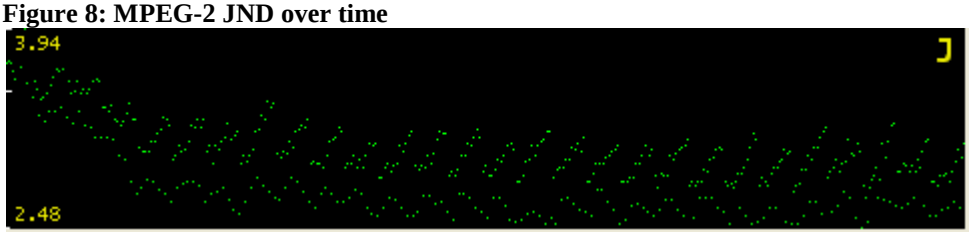


Figure 8: MPEG-2 JND over time



The MPEG-2 encoder did not start very well, but quickly got better and stayed between 2.5 and 3.0 for 90% of the video sequence.

What do these numbers indicate?

JND Score	Experts	Percentage	Description
0	2	50%	If you ask 2 experts which video is better, they cannot agree.
1	4	75%	If you ask 4 experts, 3 can clearly state that 1 of the videos is better.
2	8	87.5%	If you ask 8 experts, 7 can clearly state that 1 of the videos is better.
3	16	93.75%	
4	32	96.875%	

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5	64	98.437%	
6	128	99.219%	
9	1024	99.902%	If you ask 1024 experts, almost everyone can tell the difference (only 1 could not)

If you are used to Subjective MOS, then below is a quick and dirty guide

MOS	JND	Description
	13+	Videos are probably not aligned. View our alignment application note.
1	10-12	Very Annoying
2	7-9	Somewhat Annoying
3	4-6	Broadcast Quality
4	1-3	Production Quality
5	0	No Defects

To put things into perspective, we will use the A-B tool and show the differences between the video sequences that are greater than a certain number of pixels. First we will show mJPEG and the differences that are greater than 2 pixels. The MPEG-2 shows differences greater than 18. The differences are painted in green if the image on the right is greater than the image on the left. Yellow is painted when the image on the left is greater than the image on the right. The original image is displayed when the video sequences are within the threshold.

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Figure 9: A-B Addback Mode threshold set to 2

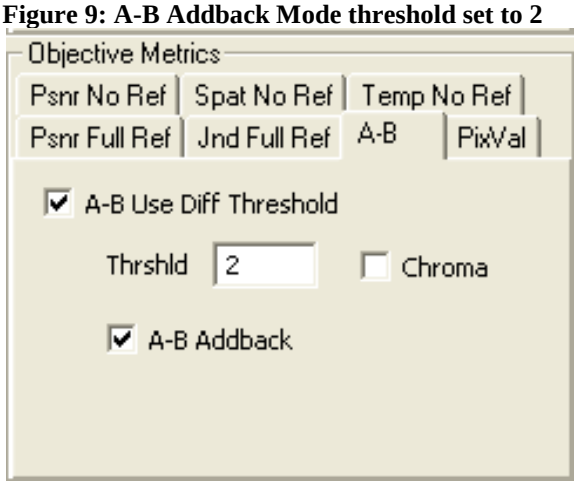

Figure 10: mJPEG pixels greater than 2

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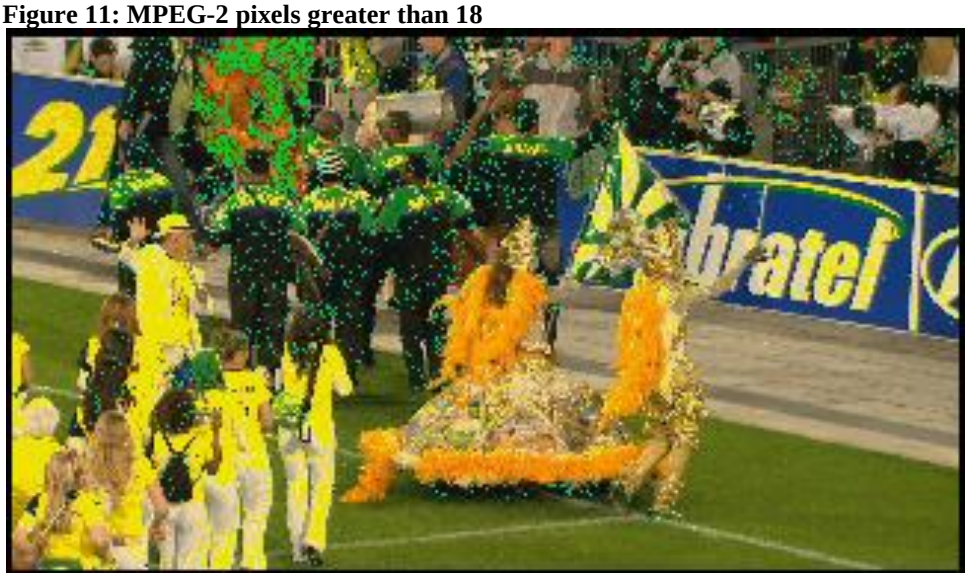
Figure 11: MPEG-2 pixels greater than 18



JND has been shown to correlate to subjective video quality scores with 75% accuracy according to VQEG studies and 90% according to the University of Texas studies.