Intel® Media Server Studio 2017 R3
Video Quality Caliper
User Guide

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## Revision History

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Overview

Intel® Media Server Studio 2017 R3 - Video Quality Caliper (VQC) is a graphical utility for objective and visual quality inspection of encoded or uncompressed videos. It is able to work with elementary AVC, HEVC and VP9 streams decoding them on-the-fly using embedded Intel® Media SDK software decoders. It also supports several uncompressed YUV video formats making it useful for the new codec development.

In order to measure objective visual quality, fast and accurate implementations of the mainstream PSNR/SSIM metrics (VQM), together with some experimental ones, are provided. Selected VQMs are visualized as a per-frame graph in the main application window together with frame preview and RD-chart toggle. Additionally, videos can be inspected per-frame with help of a details window that supports rapid switching between three streams, arbitrary zoom, color channel selection and difference highlighting.

VQC is using Qt library and D3JS visualization library, VP8/VP9 decoder implementation is based on reference WebM libvpx library.
Quick-intro: multiple file comparison

Choosing files for inspection

VQC application starts by opening the **FILE tab** for choosing the files for comparison:

Pressing "+File", "+Group", or "+Template" buttons opens the file selection dialog where the user should choose several video sequences for processing. Choosing "+File" adds single file for comparison, while "+Group" allows the user to select multiple files (by holding CTRL during selection) to be added as a group of files. Choosing "+Template" button additionally attempts to automatically add other files in the subfolder following the selected one name pattern by substituting numeric values (this is helpful to open several files encoded with different bitrates/QPs for example). In the example below Group1 was added using the "TOS_(\d+)x(\d+)\.cut\.all\.\(\d+\)\(\d+\)" regexp filename template, whereas Group2 consists of arbitrary named files:

VQC tool is able to work with several compressed video formats: MPEG2/AVC/HEVC/VP8/VP9 streams in IFV container, as well as with uncompressed YUV sequences (I420, YV12, NV12, P0x0). For complete list of supported formats, refer to release notes document. The exact format of the elementary stream is detected automatically by checking the file signature and then querying all supported decoders for the frame header; uncompressed format should be selected manually from the drop down list:
Frame width and height is either read from the encoded file header; or, if the user hasn’t selected any compressed input files, guessed by looking for the \texttt{WxH} pattern in the filename (like \texttt{yourname_720x576.yuv}); in later case user can adjust the size in the dedicated video parameters fields. In order to correctly process bitrate, user can edit FPS settings, and explicitly define bitrate for the YUVs (in case they are decoded from unsupported video format for example).

Names in the Label/Filename column are labels autogenerated from the \textit{file names}. The user can edit these fields assigning arbitrary names to the streams for further reference. Hovering over the labels will tip the user with the filename of the corresponding video. Clicking the Label/Filename title will switch this column to Filename/Label mode (and back). In this mode, user will be able to directly edit filenames thus changing video streams to be processed. Additionally for the template-based group of files, switching to the Filename/Label mode allows user to edit the group pattern, though it is recommended only for the advanced users:

If VQC tool is unable to determine the elementary stream format, added streams have different resolution or color depth, status filed will contain \texttt{ERR} or \texttt{WRN} and exact details of the error can be found out by hovering the mouse over the message. Note that the tool attempts to detect the color space automatically, but the user can also select the color space manually with the “Color Space” drop down list on the “Files” tab. Available options are BT.601, BT.709, BT.2020, BT.601-FR, BT.709-FR, and BT.2020-FR. The “FR” variants assume full-range YUV inputs, while the other formats assume limited-range YUV.
In this example first I420 YUV file have 8bit color format, and 2048x856 resolution was chosen to be the reference. For second sequence, AVC encoded format was auto-detected and since the frame size read from the stream mismatches the reference one, ERR status was set. Hovering the mouse over ERR status results in the following tip. For the third YUV sequence, 16-bit color format is implied from the P016 specification and this is not matching the reference color format. Fourth file is unaccusable, fifths have mismatching chroma format sampling, while the frame count estimation for the last YUV file (using file size) hints to the frame size mismatch:

Please, note that even though only first stream is considered OK, "calculate" button is active in the example above, as uncompressed files matching the reference color space are considered to be ready for calculation.

In addition, please note supplementary information message written on the "calculate" button summarizing the actions expected from the user or which will be carried out after this button will be pressed:

In order to proceed with the metrics calculation the user must open at least two files supported by the application (with status OK or WRN) and press activated Calculate button.

Adding single valid file (which must be set as reference as well) allows user to view it without calculating objective quality metrics by pressing View button to open details window:
All the valid files will be processed frame by frame and compared using chosen metrics (check boxes on the top of the tab) to the one selected to be the reference (radio button to the left of the filename). Files will be read until at least one of the input streams reaches the end of file or encounters other error during decoding; the user also can limit maximum number frames to process entering any positive number to “Max frames” field. For example hitting the calculate button in the configuration below:

```
will calculate by default PSNR metric for Y and chroma (UV) components for 8 AVC streams organized in two groups comparing these streams to the uncompressed YUV from the TOS_2048x856.cut.yuv file. The result may look like this (if the total number of frames is less than 100):
```

![Image of video analysis software interface showing file selection and calculation options.](image-url)
By default, all opened files, metric choices, maximum frames limitations etc. from previous sessions are not persistent between application runs, unless the user chooses "Restore Session" in "Option" to for editing the last valid input settings. Additionally application will attempt to open the previously opened directory during the file selection and position windows the same as in previous session.

**Working with the main VQC window**

For relatively small streams (less than 100 frames) the main VQC tool window contains three control elements: **preview, RD-chart, and per-frame VQM chart**:

Per-frame VQM chart is the main control element for the stream analysis. It is a two-dimensional plot of the selected VQM (Y axis) over the frames domain in the display order. Each stream is represented with its own line of the different color as well as with the active point with matching color on the RD graph. Streams in the group will have one base color and use alternated lighter/darker color for the individual stream representation.

Hovering over the active area in RD graph, the user can find details of the stream (name, average metric value, and bitrate):
Moving the mouse over the plot will highlight corresponding frame position using the blue line; at the bottom of this line frame index (0-based) is written, while at every intersection with the VQM lines, numeric value of the corresponding metrics value for this frame will be printed. Additionally, the preview element will be updated with the small video frame preview; please note, that preview might be slightly inaccurate in case of the long streams due to memory limitations.

Horizontal zoom can be adjusted using the mouse wheel or with “+” and “-” keys. Middle click (or R button) will reset the chart zoom level to the initial one (in an attempt to show the whole stream(s)), next middle click returns the zoom level to the previous state thus allowing user to quickly dive into details in the different regions of the stream from the whole sequence overview.

Left-click will adjust the frame for closer inspection in the details window (depicted using red vertical line), and will be addressed further in the next section.

RD-chart in the upper right corner of the main VQC tool window visualize the mapping of each non-reference input sequence to the phase space (bitrate, average metric). Every video stream will have the single point representation on this diagram where higher points corresponds to the streams with better visual quality, while the ones to the left have lower compression ratio. This chart is an active control useful for two purposes – to find the correspondence between color and the stream on the per-frame chart as mentioned above and to toggle the charts on the per-frame chart. Left-clicking on the active area near the stream point (round area with color highlighting) will disable/enable the corresponding per-frame curve. This feature can be used to inspect the individual curves.

Please note that the accuracy of bitrate calculation depends on the input provided by the user either explicitly specified (uncompressed videos) or calculated using FPS input (elementary streams).

For the larger streams additional control element – metrics overview pane – will be additionally popped at the bottom of the window:
It will contain the simplified representation of the per-frame metrics over the whole stream, whereas active grayed area will correspond to the zoomed-in portion in the main per-frame chart. This area can be directly controlled dragging it to the left and right, or changing size by dragging its boundaries (smallest size – 100 frames).

Choosing the “Options” tag will open the “drop-down” panel for VQM selection controls and application settings:

As mentioned above, activating “Restore session” check box will force the program restore previous successful settings in the file open tab and windows configurations including detail window split status at the application launch. All user settings are saved in the text .ini file located either in folder with the application, or in the OS specific user folder (C:\Users\name\AppData\Local\Intel\Video Quality Caliper x64\ on Win64, for example).

Checking “Enable Offset Adjustment” provides additional controls on the Files tab to handle sequences which are misaligned in time by an integer number of frames (e.g. a delay between reference and test streams). Refer to the section “Frame Offset Adjustment” for details.

In order to speed-up backward repositioning decoded frames of the A/B/C elementary video streams for all sub-views are cached in the memory. The total size of this cache is limited by the YUV Viewer cache size setting, specifying upper memory limit in MBs. By default 128 MB of memory will be used which is enough to work with 3 encoded 1080p streams (43 frames in total). In order to work with higher number of visible streams or bigger frame sizes seamlessly it is recommended to increase the cache size.

“About” section will display copyright information and selectable application version useful for bug report submission.

Metrics tab allows the user to select which metrics are going to be computed after “Calculate” button will be hit. Metrics in the “Calculate at start” list will be evaluated in two passes – starting with the first one in the list followed by the rest of metrics in the second pass. For example, in the configuration below all four available metrics will be evaluated for Y component of the frames, starting with PSNR:
The per-frame chart can simultaneously display two sets of curves (two metrics for all streams). If the new metric was not selected during the file open process, it will be computed in the background while the chart will be progressively updated. Second VQM will use its own vertical axis scaling (on the right vertical) but will use the same color for the same stream (while having a different line style):

Direct comparison of the VQMs behavior is sometimes useful to detect atypical behavior in the stream.

The vertical axis range can be adjusted by setting to global extremas (min/max), extremas local to currently visible range, or manual value in the per-frame chart controls on the Metrics tab.

Y-axis labels are active controls that can be used for rapid displayed metric selection. Left clicking the label will change the metric to display cycling around all pre-computed metrics. In order to draw the new metric or enable/disable the right metric the user should select appropriate settings on the options tab.

Pressing “Files” tag will reopen the file selection tab. The user can adjust the files and hit the “Calculate” button again, or inspect the color key matching for the current session. Changes in this tab will not affect the main window display until the recalculation requested by the user.
Comparative frame inspection

In order to visually inspect the frames and compare compression artifacts between the streams, a separate stream details window is created when user presses “Calculate” or “View”. It contains the first frame of the reference stream by default. In order to reposition the frame the user should left-click on the per-frame chart in the main VQC tool window or press left or right to move to the previous/next frames. Please note that navigating the elementary streams backward is not efficient and only partially optimized by caching a few frames. Moving beyond the stored frames can be slow.

This window can be closed without exiting the program but will be reopened every time user left-clicks the per-frame chart to reposition the active details frame.

The streams details window supports arbitrary frame magnification by mouse wheel or by “+”/”-” keys. The user can drag the content of the window to reposition the zoomed view in the video frame; middle click (or R button) unzooms the frame, while the next middle click restores the previous zoom state around the current mouse position allowing user to quickly dive into details in different places of the frame. Ultimately, at larger zoom levels the YUV component values of the corresponding pixels begun to overlay the color representation.

Special info panel can be toggled by pressing I button. Among with color channel selection, play and sync-buttons, this panel will also contain the coordinates and YUV components of the pixel under the mouse cursor:

In order to rapidly switch between video streams (displaying the same frame from different videos at the same magnification) the user may use F1/F2/F3 fast keys. The widget supports up to three streams for switching. Additionally streams (A/B/C) can be selected using context menu, by default stream A is assigned to the reference sequence:
In above example, the “veryslow” preset of the x264 encoder consistently outperforms the “superfast” preset with similar high-level conditions (like target bitrate/GOP size, etc.), except for two frames, where the PSNR quality drops. Closer visual inspection confirmed that and hinted the problem in the BRC behavior with fixed GOP from the command line, as these two frames were left from the scene interrupted by the next one.

In order to display per-pixel difference between A, B, and C user can use F4/F5/F6 fast keys, or choose it in the context menu. Comparing the differences on the frame above shows the error type for the “veryslow” settings likely caused by wrong QP adaptation.
Mastering the Details window

Functionality overview

Stream details window is opened after the metric calculation started at the first frame (frame #0) of the sequence A (reference sequence by default). The frame, currently opened in the details window (active frame) is highlighted on the per-frame chart at the main window with the deep red color. At any time user can close the details window (the highlighting color will be changed to the pale red) but repositioning the active frame with left/right keystrokes or left-clicking on the PFM chart will reopen the details window. By default the details windows opened in the single frame view mode:

Switchable info-panel (I key toggle) at the bottom of the window can be used to select the frame display mode (YUV, only Y, only U mapped on luma component, or only V mapped on luma component). Displayed color channel can also be selected using context menu. Moving the mouse over the frame content will display the coordinates and YUV components of a pixel (or difference) under the cursor:

Additionally after the metric calculation is finished this window can be used for video playback. To start / stop the playback the user should either press Play button at the Info panel or hit the space key. The stream will be played with the FPS defined in the file open tab, or at maximum possible FPS in case the program is unable to keep up with real-time playback. To toggle between slowed-down the playback with 1 fps or normal speed playback, press F key.

Visible area of the stream details window can be recursively split in order to simultaneously review several streams or inspect the same stream at different positions and zoom levels. Each sub-view will have full functionality and can be controlled independently, unless they are source or offset liked to other views.
Split view display mode

In order to switch into the split view mode, the user should either press **H** key to split the horizontal direction by the middle vertical line, or **V** key to split the vertical direction pointing to the sub-view he wants to split. These operations are also available through the context menu:

![Split view display mode](image)

In the example above, the single view with enabled auto-fit was split in horizontal direction. Each sub-view inherit the properties of the parent view. To reverse the operation the user should either press **M** key or select Merge from the context menu.

Each sub-view can be controlled independently to construct the necessary view configurations. For example the user can set-up the zoomed split screen view (low bitrate AVC to the left, and original to the right):

![Split view display mode](image)

The simplest way to configure the view into the split screen mode is to select the overall zoom and position using single view mode, then split the image and choose different sequences for each sub-view. Another option is to use frame expansion syncing toggle, which will require info panel to be displayed. Holding CTRL key the user should click on master view **E** toggle button, then anywhere on other sub-views to sync the extension pane.
Chosen sub-views will be considered as a single window coordinate space for the purposes of translation and relative resize, whereas each view can have its own displayed content. Additional syncing modes (S/O/E) are described in the next sections.

The playback mode in the split view mode could be used to highlight graduate changes of the frame details when the object moves from one sub-view to the other one. Info panels can be individually opened or closed in each sub-view. In order to reverse the info panel status for all views simultaneously the user can use the Shift-I hotkey.

Another example of the useful split screen configurations is the side-by-side mode:

In this configuration, the same zoomed frame fragment of different video streams (different codecs or bitrates) is inspected for comparative review. On this picture, top-left view contains original video, top-right – AVC at 700 kbps, bottom-left – AVC at 1000 kbps and bottom-right – AVC at 2000 kbps. We can clearly see the details improvements with increase of bitrate. Switching on info-panel will display the stream labels if needed.

The best way to configure the split view to the side-by-side review is to use the offset syncing toggle, which will also require info panel to be displayed. The user should split the view three times (for example horizontally and twice vertically for both left and right sub-view) and select the required frame fragment on any view making sure the info panel is displayed. Holding the CTRL key the user should click the mouse on the O button (stands for offset sync), which will become green:
Afterwards, still holding the CTRL button the user should click on the views he want link their displayed region settings with the first view. Clicked views will immediately change the ROI matching the first view, and highlight their O button with green color. Releasing the CTRL at any time will end the linking procedure. To review the linked status, hoover the mouse over the O button on any view. If this view is offset-linked to other views, on all info panels for the linked views button O will turn green.

Changing the visible region in any of the offset-linked views will affect the whole group, so fine-tuning the display and zoom position in one of the linked views will do the same operation of other views. For side-by-side review, the user may offset-link all sub-views, chose the right ROI in one view and then select required different video streams in other sub-views.

To break the link, simply click the O button again.

Other useful split view mode is multiple details review. In this mode, the user can set-up the composite screen with the big sub-view to display the whole frame while smaller sub-views could be used to display various sub-regions of this frame in details using zoom-in:

The split line can be dragged to resize the sub-views to form the arbitrary screen subdivision. Additional usability can be achieved if switching of the video source will be synced over all sub-views and this can be achieved using source syncing toggle. The toggle behavior matching the offset syncing toggle, using S button on the info-panel. Holding CTRL key user left-clicks the views he wants to sync. Switching video source, for example by F1/F2/F3 keys will affect all synced views changing the picture origin simultaneously.
The described side-by-side, split-screen, and multiple details modes of the split screen configuration is just a few useful examples. Program is flexible enough allowing user to create their own layouts targeting the specific needs. Sometimes it is important to view the picture in its original size without any magnification. The user can switch of the frame zoom or return to previous zoom level using O key.

**Difference highlights**

In order to inspect the frame difference Caliper program have the special visualization mode. Choosing the corresponding video pair A-B, A-C or B-C from the context menu or by pressing F4/F5/F6 keys will switch the view to the difference display mode:

![Difference visualization mode](image)

In this mode, difference is visualized using color intensity in logarithmic fitting curve – the deeper the color, the bigger the difference. Greyscale image corresponds to exact matching video frames.

For Y-only difference mode (top-right) blue colors are used to highlight the low to medium differences, while red color is used for areas with the medium to very high differences. For U-only mode (bottom-left), orange color is used, for V-only mode (bottom-right) – green color. Combined YUV mode (top-left) will select the color according to the channel with maximum difference. Usually, green and orange areas in YUV mode highlight the areas with clearly visible chroma distortions. A background color blackness uses the fitted average Y component of two frames, allowing the user to better align difference artifacts with the frame features.

Additionally the user may hold the D key (or <Alt>) to highlight the minor differences. In this mode any difference will be colored as red, while following pixels on the same row and column will have the darker shade making it possible to spot even on the reduced resolution difference:
YUV Histogram

During stream playback, the “X” hotkey can be used to toggle a histogram of Y, U, and V coefficients for each frame. The histogram is overlaid on the playback window, in the upper left corner.

The plot indicates the relative frequency at which each possible value for Y (white), U (blue), and V (red) occurs in the current frame. The x-axis runs from \[0, 2^{\text{bitsPerPixel}} - 1\], corresponding to these Y/U/V values, and the y-axis is normalized such that the most-common value for each plane touches the top edge. Both the x and y axes are scaled linearly. In YUV channel display mode (as shown above) all three histograms are included in the plot. If a single channel is selected, only the corresponding histogram is displayed. The histogram window is not displayed in difference visualization (A – B) mode.
Integration with Intel® Video Pro Analyzer

Assuming the user owns a copy of the Intel® Video Pro Analyzer, selected frames of the VPA supported video stream can be easily opened for closer bit-stream syntax inspection from the details window of the Caliper application. In order to do that, used should correctly setup the path to the VPA application in the options tab for the main Caliper window:

![Caliper Interface](image1)

Correctly detected VPA application version can be found in the About section of the Options tab. If valid version of VPA was detected, additional option - Analyze in VPA - becomes available in the context menu of the details window sub-views if the video stream is supported by VPA.

![Context Menu](image2)

Selecting this option or pressing A hotkey will start VPA application in separate process. It will be automatically repositioned to the selected frame in display order. Additionally, if the reference stream is uncompressed, it will be opened by VPA as the debug YUV:

![VPA Interface](image3)
Advanced VQC features
Custom uncompressed YUV files support

In order to provide the user with flexible controls over uncompressed file input and format drop-down list, special dialog was added to the latest VQC release. This dialog can also be used to determine the YUV frame size, in case this size can’t be determined from the filename or other files. To open this dialog the used should choose “Edit” element in the format selection drop-down list:

It opens the following sub-pane with the filename on top, drop-down list control to the left, adjustable YUV format description, adjustable default size info, first frame preview, and width / height sliders or edit fields:

To control the format drop-down list the user can enable/disable standard FOURCC formats by clicking on the “eye” icon to the left of the standard name. For example, if the user knows he will not work with high-bit-depth YUVs he can disable all 10+ or 4:2:2+ formats and press “Apply settings” to have the resulting drop-down look like this:
In case the user needs to add some variety of the format unlisted in the list all standard types he can create his own by directly editing the underscored elements in the format description. For example, if he needs NV12 variety with Cr component interleaved first (instead of standard Cb) and BT.709 color representation he can edit the description creating his own type MyNV12 and press “Apply settings” to add it to the list:

Default frame size is also editable by either dropdown from the standard frame sizes:
Alternatively, size can be changed by dragging the frame size sliders or entering custom values into the editable fields at the bottom right of the pane. Also frame size can be precisely incremented/decremented selecting the slider control and using arrow buttons. Preview will be adjusted automatically, and scaled proportionally to fit the preview area.

Please note, that custom YUV formats can’t be disabled from the list – only deleted from it. Also, note that it is impossible to delete/disable currently selected format.

To exit the pane without saving, press “Close” button.

Data exporting capabilities

Screen content capturing

The user may want to export the screen content to be included in the presentation materials. VQC supports screen capturing with the Ctrl-P hotkey. It opens the file selection dialog and saves the screen content to chosen PNG file:

![Screen content capturing](image)

This image can be directly embedded in the presentation materials, or send to the collaborator over the internet. The hotkey works both on main and on the details window and captures inner window content without window title or borders.
Video quality metrics exporting

Computed metrics can be exported to CSV file using F10 hotkey in the main window. File selection dialog appear and all active streams on the per-frame chart will be exported to the selected file using following format:

<table>
<thead>
<tr>
<th>Stream</th>
<th>Metric</th>
<th>Average 0</th>
<th>Average 1</th>
<th>Average 2</th>
<th>Average 3</th>
<th>Average 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="mailto:TOS_1.0Mbps@24_u1.avc">TOS_1.0Mbps@24_u1.avc</a></td>
<td>PSNR-Y</td>
<td>34.5989</td>
<td>35.4947</td>
<td>33.1343</td>
<td>33.0476</td>
<td>34.4909</td>
</tr>
<tr>
<td><a href="mailto:TOS_1.0Mbps@24_u1.avc">TOS_1.0Mbps@24_u1.avc</a></td>
<td>PSNR-U</td>
<td>41.4497</td>
<td>42.2773</td>
<td>42.4805</td>
<td>42.5567</td>
<td>42.0695</td>
</tr>
<tr>
<td><a href="mailto:TOS_1.0Mbps@24_u1.avc">TOS_1.0Mbps@24_u1.avc</a></td>
<td>PSNR-V</td>
<td>41.6187</td>
<td>41.1331</td>
<td>40.8791</td>
<td>40.8647</td>
<td>40.6669</td>
</tr>
<tr>
<td><a href="mailto:TOS_1.0Mbps@24_u1.avc">TOS_1.0Mbps@24_u1.avc</a></td>
<td>PSNR-O</td>
<td>35.9408</td>
<td>36.7608</td>
<td>34.597</td>
<td>34.5174</td>
<td>35.8223</td>
</tr>
</tbody>
</table>

Please, note that then exporting floating point values, symbol "." is used to delimit the fractional part which can cause the incorrect numeric handling in the systems with different locale settings (for example, if "," symbol is used for delimitation);

Playback capturing

In order to be able to showcase the visual artifacts perceived only during dynamic playback, VQC offers the ability to capture the content of the details window during playback. In order to turn the capturing, the user should press B hotkey toggle. The user will be prompted to select the output folder, then the program will be switched to the recording playback mode and the “Play” button on the info panel will be updated accordingly:

Pressing this button, or hitting “space” will start the playback and recording. Stopping the playback or reaching the frame limit (captured video length should be less than 100 frames) will end the capture process, the frames will be processed and dumped to the uncompressed file in I420 format for further processing. Name will be chosen automatically to match the vqcgrab_WxH.yuv pattern.
Frame offset adjustment

In some situations the input files may be misaligned by an integer number of video frames. For example, a transcoding process may include preprocessing steps which introduce a delay of several frames between the source file and the new encoded stream. In order to obtain valid VQM data, this misalignment must be corrected before running metrics calculations.

VQC includes the ability to skip an arbitrary number of leading frames in each input file (reference and/or test). This feature is enabled by checking “Enable Offset Adjustment” in the Options tab.

When this box is checked, two additional controls are added for each input file in the “Files” tab.

If “Manual” is selected in the Offset Adjustment column, then the number of frames specified in the Offset Frames field will be skipped in that file prior to VQM calculation. If “Disabled” is selected in the Offset Adjustment column, then VQM calculation begins with the first frame of the given file. The value in Offset Frames must be an integer value greater than or equal to zero. Specifying a value greater than the number of frames in the file will cause VQM calculation to fail, as no decoded data is available.

The detail and preview windows take any offset into account as well. That is, frame 0 in the metrics plot corresponds to the first processed frame in every input file.
Stream information

A summary of important properties for each stream can be accessed by clicking the "I" button, located to the left of the filename. This opens a popup window which displays information such as the detected codec, stream dimensions, bit depth, chroma sampling, etc. This can be helpful in resolving any format mismatches which have caused VQC to skip certain streams during metrics calculation (e.g. if the resolution of the test stream does not match that of the reference stream).

VQC also displays the size (in bytes) and length (in frames) of each stream. In the case of raw video files, the number of frames is calculated using the width, height, and raw file type (I420, P010, etc.) specified by the user. For compressed streams, the number of frames is calculated by quickly decoding each stream. As this process may take several seconds for longer streams, the decode process is run in the background, and the user can continue to use VQC while the stream length is being calculated. The relevant fields in the Stream Information window will display “Calculating...” during this time, and will be updated automatically after the stream length has been determined.

Bitrate and Duration are calculated using the FPS value specified by the user. Changes to this value will be detected automatically the next time Stream Information is accessed.

![Stream Information Window](image)
Main window
Left – move the active frame to the previous one;
Right – move the active frame to the next one;
Plus – zoom-in the per-frame chart around current frame;
Minus – zoom out the per-frame chart around current frame;
R – toggle: restore 100% zoom on the per-frame chart / restore previous zoom level around current frame;
D – open detailed window on current frame;
CTRL-P – save the window content to the PNG file;
F10 – save computed metric values (for active streams) to the CSV file;

Details window
Left – move the active frame to the previous one;
Right – move the active frame to the next one;
Plus – zoom-in the frame around cursor position;
Minus – zoom out the frame around cursor position;
R – toggle: restore auto-fit the view mode / restore previous zoom level around current cursor position;
O – toggle: restore 100% frame zoom level / restore previous zoom level around current cursor position;
I – toggle: display info-panel in the current view / hide info-panel in the current view;
X – toggle: display YUV histogram in the current view / hide YUV histogram in the current view
SHIFT-I – toggle: display info-panel in all views / hide info-panel in all views;
A – open current stream in VPA application (if supported) on the selected frame;
Space – Play/Pause;
F – toggle slo-mo playback at 1 FPS (affects playback speed only);
D – holding the key in difference display mode will switch highlighting mode helping user to find one-pixel differences;
H – split the current view along the horizontal axis;
V – split the current view along the vertical axis;
M – recursively merge the split sub-views up to the parent of the current sub-view;
F1 – select the stream A as a view source;
F2 – select the stream B as a view source;
F3 – select the stream C as a view source;
F4 – select the A-B difference as a view source;
F5 – select the A-C difference as a view source;
F6 – select the B-C difference as a view source;
F7 – select the YUV channel display mode;
F8 – select the Y channel display mode;
F9 – select the U channel display mode;
F10 – select the V channel display mode;
CTRL-P – save the window content to the PNG file;
B – toggle Record mode, following playback will be saved to the target folder (in I420 format);

Custom metrics plugins

In addition to the video quality metrics supported natively by VQC (such as PSNR, SSIM, etc.) users may implement their own custom metrics via a C++ plugin API. Metrics plugins which are implemented according to this specification behave exactly like the metrics supplied with VQC, and results can be inspected with the same graphing and analysis used with the built-in metrics. Complete documentation is provided in the “Video Quality Caliper Reference Manual for Metrics Plugin API”, included in the same directory as this user guide. Please refer to this manual for more information.
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D3-tip
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