MSU Subjective Comparison of Modern Video Codecs

Project head: Dmitriy Vatolin

Organization of assessment: Alexander Parshin, Oleg Petrov

Report preparation: Oleg Petrov

Verification: Alexander Parshin, Artem Titarenko

Codecs:

- DivX 6.0
- XviD 1.1.0
- x264 svn-352M
- WMV 9.0

Number of experts: 50

Assessment method: SAMVIQ

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CS MSU Graphics&Media Lab

Video Group

http://www.compression.ru/video

Table of Contents

Gratitude

Authors want to thank Stass Soldatov and Alexey Moskvin for help in preparation and verification of the report, and all of the experts who took part in a quality assessment for their priceless help in creation of this comparison.

Comparison abstract

In this comparison we evaluate the quality of four popular codecs on two bitrates (690 and 1024 kbps) using subjective assessment. We use SAMVIQ as a subjective testing methodology. An average subjective opinion on the quality of an encoded video is the most important characteristic of codec's performance. **Fifty experts** took part in the subjective assessment; their marks form resulting codec's rating. In addition, we measured objective metrics (PSNR, VQM and SSIM) and evaluated their ability to predict subjective opinion on our test set. Results of subjective evaluation prove that x264 codec of H.264 standard provides a significantly better subjective quality than other widely-spread codecs that took part in the comparison. It is shown that PSNR cannot always be reliable measure of video quality in practical cases (i.e., not specially created to corrupt the measure).

Overview

Codecs

Codec	Vendor	Version
DivX	DivX Networks	6.0 b1571-CenterOfTheSun
XviD	Open Source project	1.1.-125 (“xvid-1.1.0-beta2”)
x264	Open Source project	Core 48 svn-352M by Sharktooth
WMV	Microsoft Corporation	9.0

Encoders’ settings

Codec	Parameter	Values
DivX	Bitrate	690 kbps, 1024 kbps
XviD	Target bitrate	690 kbps, 1024 kbps
x264	Average Bitrate	690 kbps, 1024kbps
WMV	Bit rate	700000 bps, 1048576 bps

Other settings were left to defaults. Default values are the values that are set after a codec is installed, you can see them on codecs’ screenshots.

Decoders’ settings

Decoders that are provided with codec were used for decoding of sequences of all codecs except for x264. For decoding files compressed with x264 we used popular tool “ffdshow”, version of ff_x264.dll is 33 by Milan Cutca. All decoders’ settings were let to defaults.

Sequences

The following table contains properties of the encoded sequences that were shown to experts (see “Encoding of sequences”).

Name	Length [frames]	Length [seconds]	Resolution	Source
Battle	257	10.71	704x288	MPEG2 (DVD)
Rancho	240	10.01	704x288	MPEG2 (DVD)
Matrix sc.1	250	10.00	720x416	MPEG2 (DVD)
Matrix sc.2	250	10.00	720x416	MPEG2 (DVD)

Rules and goals of the testing

Goals of the subjective codecs assessment

During last few years many comparisons of video, audio and image codecs were carried out by our Graphics & Media Lab at Moscow State University (available at www.compression.ru/video). All of them used objective metrics like PSNR, VQM or SSIM. This fact has raised reasonable questions on adequacy of objective measures to the subjectively perceived quality.

Some organizations like VQEG (Video Quality Experts Group) and ITU (International Telecommunication Union) have held subjective assessments of video quality and evaluated adequacy of objective video quality metrics [5]. Most of comparisons were held on TV material and MPEG2 codecs. Only recently appeared the comparisons which evaluate modern PC-oriented codecs that are able to operate on low bitrates.

Goals of our assessment are **subjective comparison of new versions of popular videocodecs**, comparison of results with objective metrics and subjective assessment technology testing.

Choice of video sequences and set of bitrates

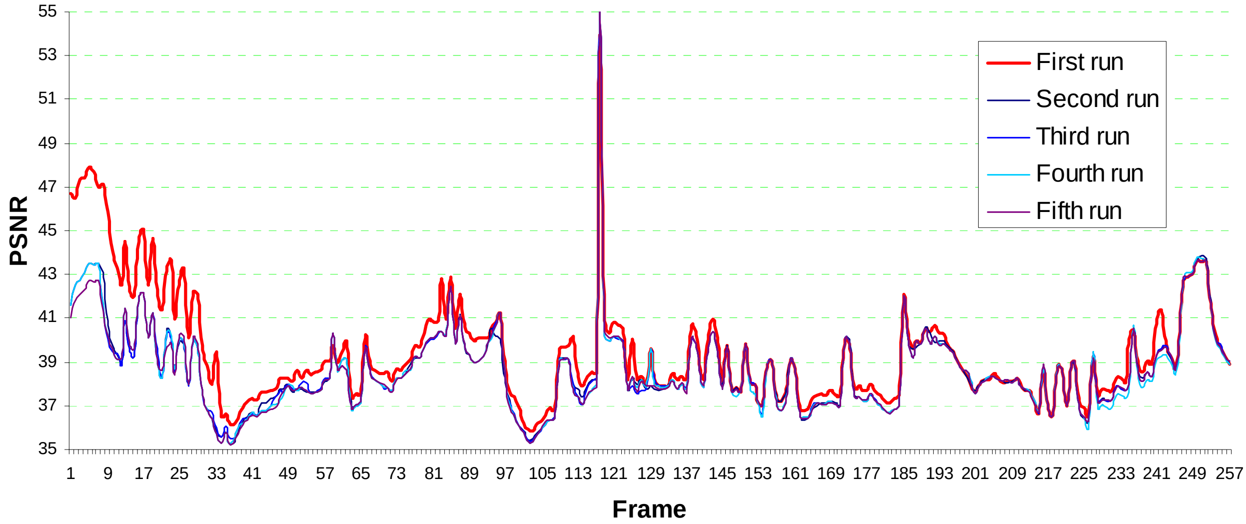
We were limited in amount of bitrates and video sequences, because each expert was to evaluate each sequence compressed with each bitrate at least once (for more details see "Method of the subjective assessment" below). Therefore we decided to concentrate on one application area of video codecs – films compression.

Four scenes from "Terminator 2" and "The Matrix" were chosen: two of them with average motion and two with very fast one. Distortion on scenes with high level of motion is often the main factor of annoyance for a viewer of a compressed film. We chose two typical bitrates for film compression – 690 kbps and 1024 kbps[1].

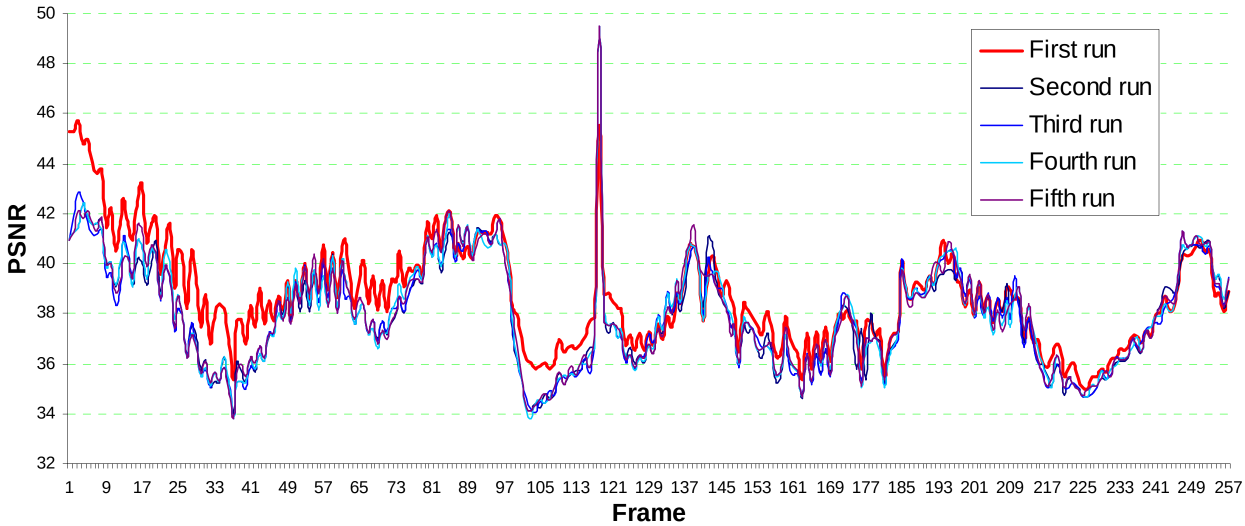
Encoding of sequences

Sequences were encoded using one pass mode without subtle tuning of codecs' settings (most settings were left to default values). Only one parameter corresponding to the bitrate of compressed sequence was changed. Test sequences were about 10 seconds length, so the following technique was used to stabilize a codec: each sequence was repeated five times, compressed and the last repetition was cut from compressed sequence. This repetition was shown to the experts.

[1] 690 kbps – one movie in a medium quality for a CD, 1024 kbps – one movie in a high quality for two CDs or two movies for a DVD



Picture 1. PSNR for repetitions of the "Battle" sequence, WMV 690 kbps



Picture 2. PSNR for repetitions of the "Battle" sequence, XviD 690 kbps

On the PSNR graphs for repetitions of the "Battle" sequence it is clearly seen that the codec stabilizes on second repetition, and the results of the first pass are too optimistic.

We used the "Direct Stream Copy" function from VirtualDub to cut the last repetition from a compressed sequence. Fortunately, all codecs on all sequences (except "Battle") made a key frame in the beginning of the last repetition, so it was possible to extract it. On the "Battle", probably due to fast motion, all codecs placed a key frame 10 frames before the last repetition, but this span is not big enough to influence results.

According to the following table, all codecs managed to reach the desired bitrate with satisfactory precision.

	690 kbps				1024 kbps			
	Battle	Matrix sc.1	Matrix sc.2	Rancho	Battle	Matrix sc.1	Matrix sc.2	Rancho
DivX	692	690	687	688	1044	1020	1026	1028
XviD	681	685	680	687	1013	1034	1025	1017
x264	688	603	687	697	1021	907	954	1031
WMV	692	693	667	697	1034	1049	1046	1045

Method of the subjective assessment

Idea of subjective comparison is to demonstrate video, processed with different sequences, to a group of experts and to record their impressions of video quality. There are a lot of subjective video quality assessment methods, many are described in recommendations of the ITU [1]. Unfortunately, most of them are targeted to TV material, and are not very convenient for conducting test on PC.

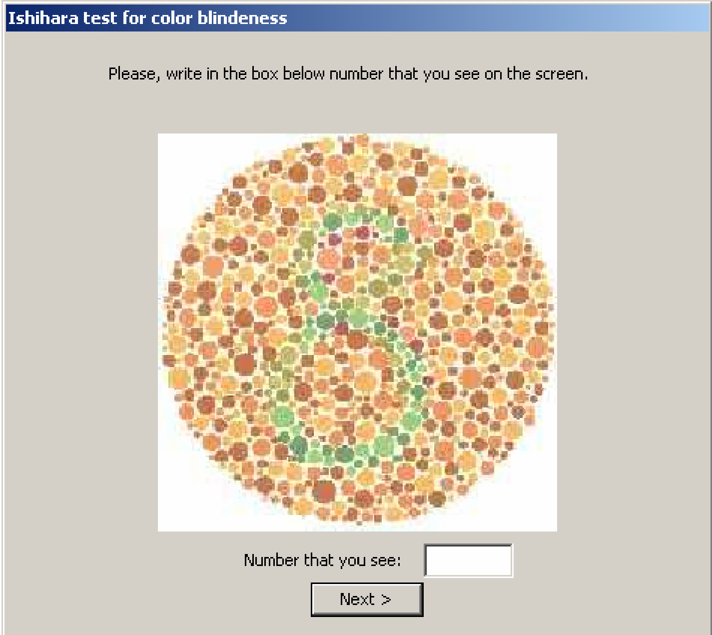
For our assessment we chose SAMVIQ (Subjective Assessment of Multimedia Video Quality, [2]) test methodology. It was developed by the EBU (European Broadcasting Union) specifically for multimedia codecs comparison, it is easier to use and more convenient for subjective assessments on PC than other comparison methodologies. Among other subjective testing methods, it is implemented in the “MSU Perceptual Video Quality tool” [6]. This tool was used for the current comparison.

Assessment steps:

1. Expert inputs his or her name (any unique sequence of symbols).

Picture 3. Name input dialog

2. Test for a color blindness (standard Ishihara test charts).

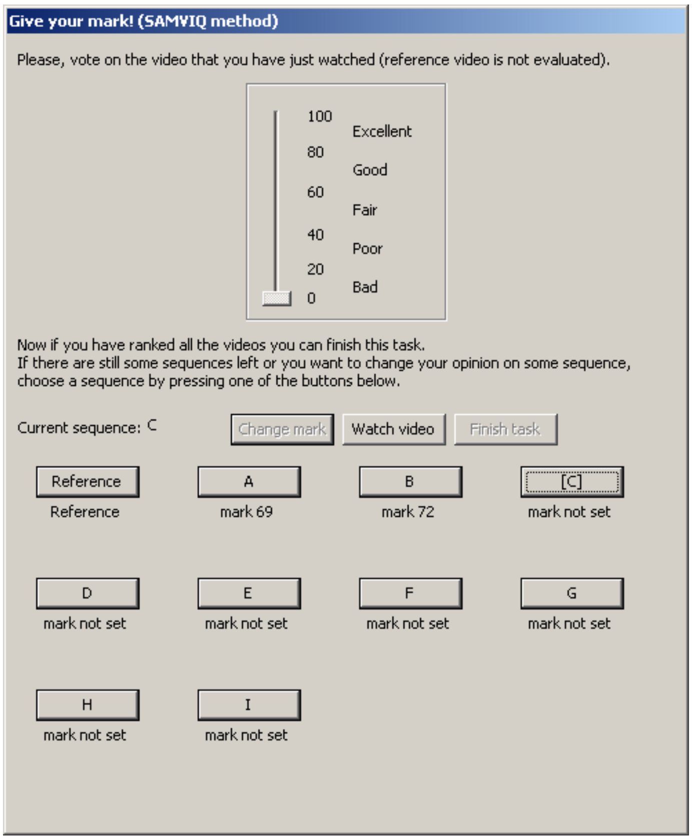


Picture 4. Color blindness test example

3. For each version of test sequence:
    1) Reference (source) video is demonstrated.

Picture 5. Player view

    2) While there are still unwatched compressed versions of the current sequence, expert chooses a video, watches and rates it. **Mark belongs to the segment from 0 to 100, the higher the better**. Mark of a video that was already evaluated can be changed at any moment.



Picture 6. Rating dialog

3) If all possible variants of test sequence are ranked, expert can finish it and proceed to the next test sequence. Expert can review any variant of a current test sequence any number of times.

Different versions of test sequence are hidden beneath letters from A to I, so **expert is not aware of codec that he is evaluating**.

Uncompressed (reference) video[2] is explicitly accessible through "Reference sequence" button, but is not evaluated when played with this button. In addition it is hidden among other letters and is evaluated along with compressed ones. Expert was ought to evaluate 9 versions of each sequence (4 codecs x 2 bitrates + 1 hidden reference video).

Organization of the assessment

The subjective assessment was carried out in two days. **50 experts** took part in it, 14 of them were a video specialists. Three types of monitor were used, 6 x 15" CRT Dell, 1 x 17" CRT Samsung and 2 x 17" LCD Samsung, they were placed in two separated rooms (as stated in [8], monitor type has no significant influence on video quality testing). Up to 9 experts simultaneously took part in the assessment. Quiet atmosphere was maintained throughout the testing, monitors' settings were calibrated. All experts were instructed on the goals and the process of the testing.

[2] Reference video was compressed with lossless codec Huffyuv v2.1.1

Sequences used in the assessment

Battle

Battle, frame 215

Name	Battle
Resolution	704x288
Features	Fragment of the “Terminator 2” movie. Difficult for compression: variable brightness, quick motion and frequent scene changes.

Rancho

Rancho, frame 149

Name	Rancho
Resolution	704x288
Features	Fragment from the “Terminator 2” movie. Slow motion in the beginning, then scene change followed by fast motion.

Matrix sc.1

Matrix sc.1, frame 178

Name	Matrix sc.1
Resolution	720x416
Features	Fragment from “The Matrix” movie. Consists of two parts: in the first one camera follows intruding soldiers, in the second one it is rotating. Motion is not very fast but is quite complicated.

Matrix sc.2

Matrix sc.2, frame 52

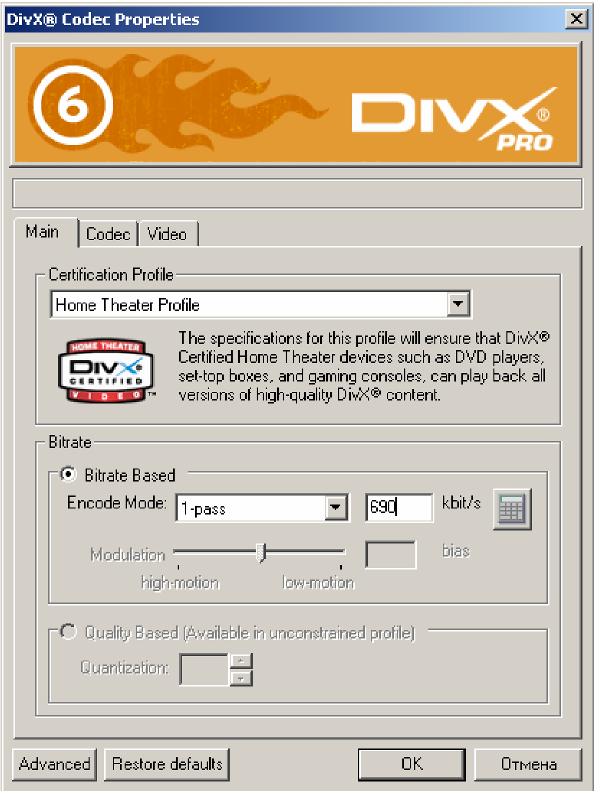
Name	Matrix sc.2
Resolution	720x416
Features	Fragment from “The Matrix” movie. Frame is filled with small parts of walls that are moving absolutely chaotically. Motion is not fast, but hardly predictable.

Codecs used in the testing

DivX 6.0

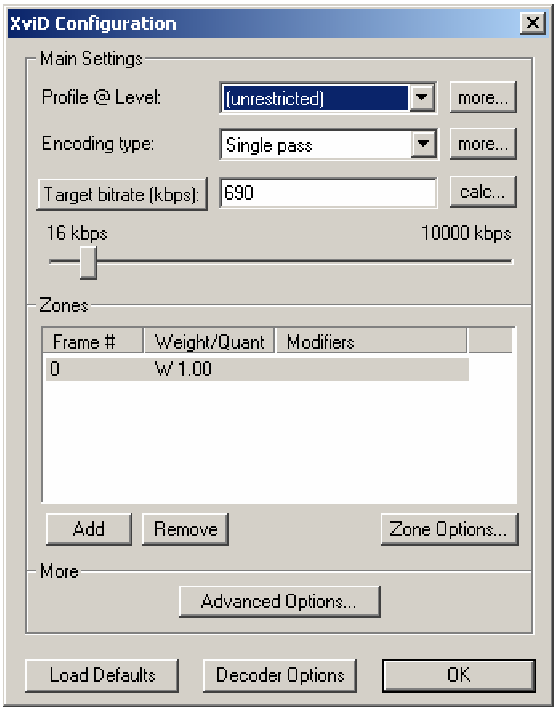
MPEG4-ASP codec. “Create Bundle” package was used for the compression and the objective measurements, “Play Bundle” package was used for the subjective assessment.

For encoding this codec was installed on a clean system, no codec settings except “Bitrate”-“kbit/s” were changed.



XviD 1.1.0-beta2

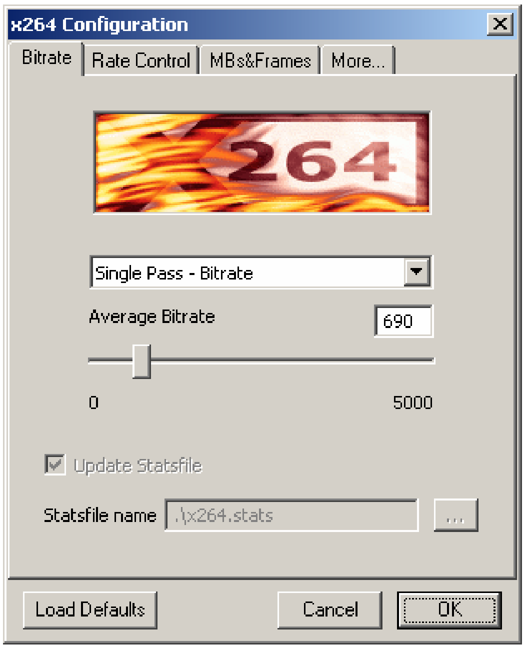
Open source MPEG4-ASP codec. We used the most recent version on the moment of the testing. Despite the fact that it is still in “beta” status, we did not experience any problems with it during the testing, and decided to use it because it was 1 dB better than the previous stable version. “Target bitrate” parameter was changed.

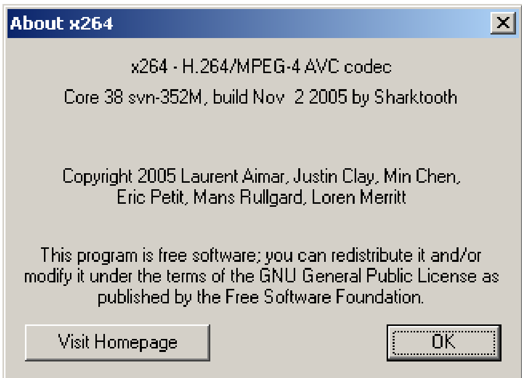


Unfortunately, in the decoder of this version deblocking was disabled by default. It was not enabled due to the policy of non-intervention into codecs' parameters – this is the actual quality that an average viewer of an encoded film will get.

x264 svn-352

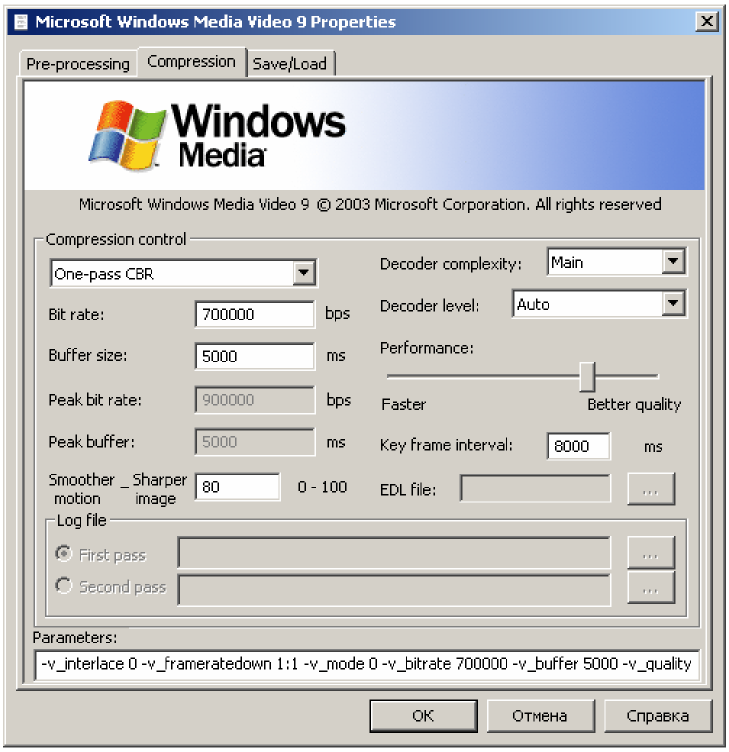
Open source H.264 codec. Was used only for compression. "Average Bitrate" parameter was changed.





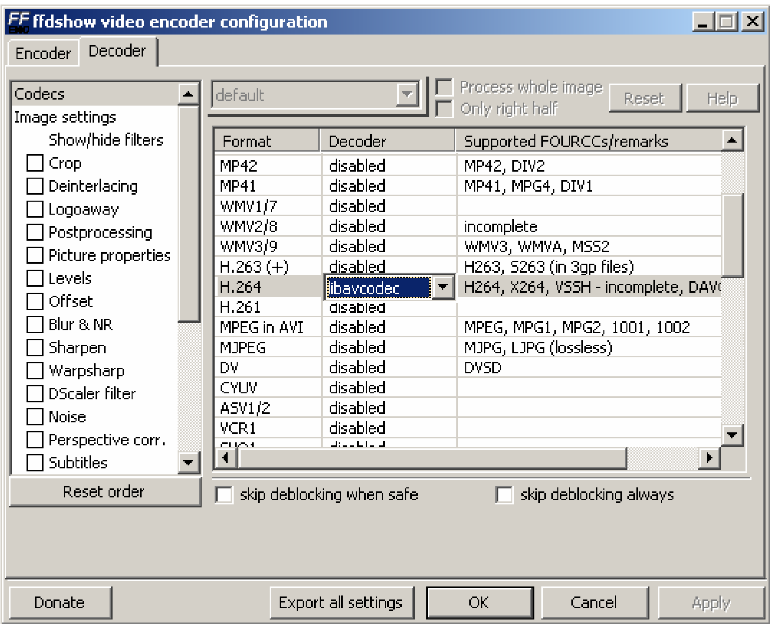
WMV 9.0

Freeware codec of proprietary format. Decoder is included with latest versions of Windows. "Bit rate" parameter was changed



ffdshow

Was used only for decoding of stream compressed with x264, version of ff_x264.dll is 33, build data Aug 10 2005 16:33:17



Results of the assessment

Analysis of the subjective results

Average subjective mark of video sequence is named MOS (Mean Opinion Score). This mark is obtained by simple averaging of subjective scores:

$$MOS_k = \sum_{i=1}^{\text{experts\_num}} \frac{\text{mark}_{\text{i,k}}}{\text{experts\_num}}$$

Where k – number of sequence for which MOS is calculated;

$\text{mark}_{i,k}$ – mark given by i-th expert to k-th sequence;

experts_num – overall number of experts.

To illustrate different dispersion of individual marks for each MOS, left and right borders of 95% confidence intervals were counted.

To estimate probability that experts were able to distinguish two codecs on a given sequence, we calculate z-test for each pair of codecs and bitrates. We used following formula to estimate this probability:

Let x_1 and x_2 be the subjective scores for two sequences. Then

$$z = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{\frac{Var(x_1) - Var(x_2)}{\text{experts\_num}}}}$$

Where $\overline{x}_1$ and $\overline{x}_2$ - MOS for first and second sequences;

$Var(x_1)$ and $Var(x_2)$ - variations of subjective marks;

experts_num – total amount of experts.

And the probability is

$$p(z) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{z} e^{-z^2/2} dz$$

Objective metrics

For all sequences PSNR, VQM and SSIM were measured with MSU Video Quality Measurement Tool [7].

PSNR is the most popular metric. Its sense is similar to the mean square error, but it is more convenient to use due to the logarithmic scale.

$$PSNR(x,y) = 10 \cdot \log_{10} \frac{255^2 \cdot n \cdot m}{\sum_{i=1}^{n}\sum_{j=1}^{m}\left(x_{i,j} - y_{i,j}\right)^2}$$

There are a lot of examples when PSNR does not reflect subjective quality.

VQM [3] and SSIM [4] are relatively new metrics that pretend to reflect subjective opinion.

To compare objective metrics' prediction, their results must be mapped on common scale. According to the procedure described in [1], results of each metric were mapped to the subjective data scale using the following **fitting function**:

$$O^{\text{fitted}} = \frac{1}{1 + e^{g*O+d}}$$

Where

O – objective data;

O^{fitted} – fitted objective data;

g and d – parameters.

Parameters g and d were selected to minimize sum of squares of differences between O^{fitted} and subjective data:

$$g, d : \sum (O^{fitted} - S)^2 \to \min$$

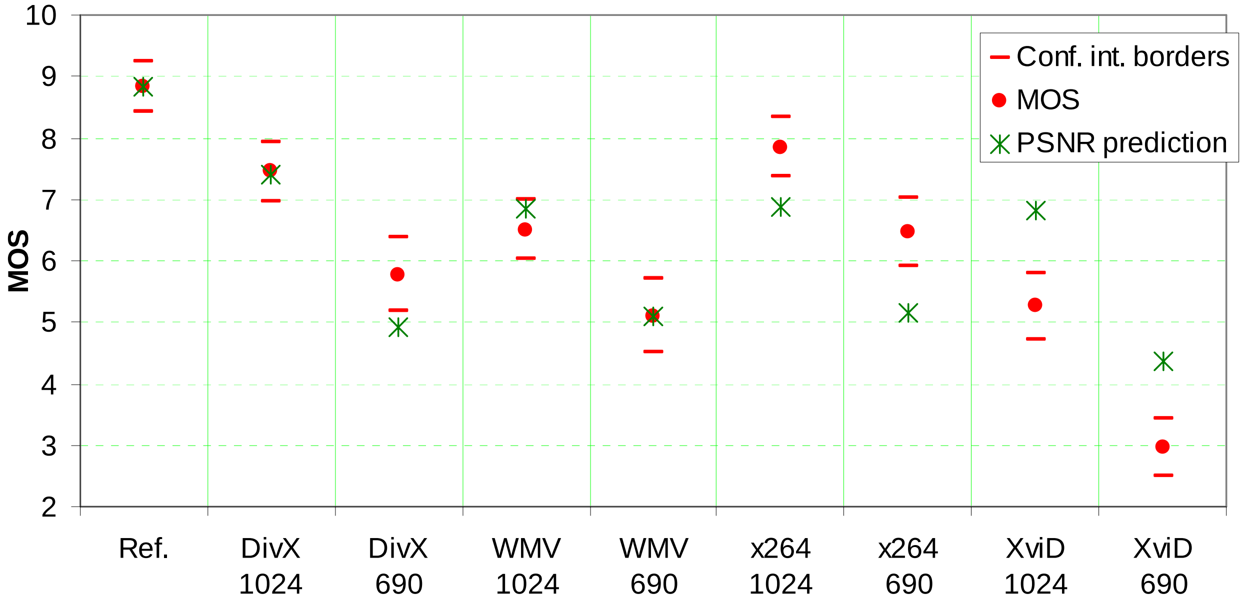
Where S – subjective data.

Results of fitting process can be regarded as a prediction of a subjective opinion by an objective metric.

MOS+PSNR/bitrate graphs

On the following graphs one can see subjective data for each sequence, its' 95% confidence intervals and MOS values predicted by PSNR[3] (after fitting).

Battle



Picture 7. Battle

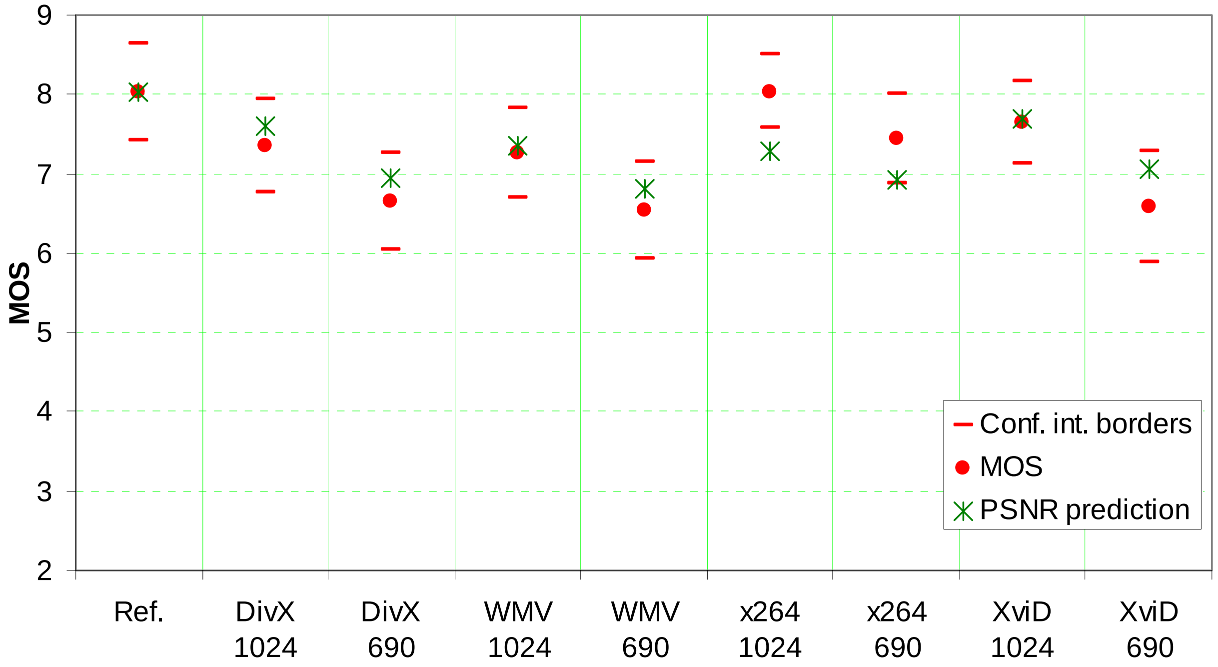
The "Battle" sequence is the most difficult one for codecs. PSNR is wrong in a number of points, for instance on x264 690 and XviD 1024 PSNR values contradict subjective scores. x264 is the absolute leader on all bitrates, followed by DivX, WMV and XviD.

Z-test table is shown below (probability that experts distinguished two sequences).

Battle	Ref.	DivX 1024	DivX 690	WMV 1024	WMV 690	x264 1024	x264 690	XviD 1024	XviD 690
Ref.	1	1	1	1	1	1	1	1	1
DivX 1024	1	1	1	1	1	0.87	1	1	1
DivX 690	1	1	1	0.97	0.94	1	0.95	0.89	1
WMV 1024	1	1	0.97	1	1	1	0.53	1	1
WMV 690	1	1	0.94	1	1	1	1	0.65	1
x264 1024	1	0.87	1	1	1	1	1	1	1
x264 690	1	1	0.95	0.53	1	1	1	1	1
XviD 1024	1	1	0.89	1	0.65	1	1	1	1
XviD 690	1	1	1	1	1	1	1	1	1

[3] PSNR was measured with MSU Video Quality Measurement Tool[7]

Rancho

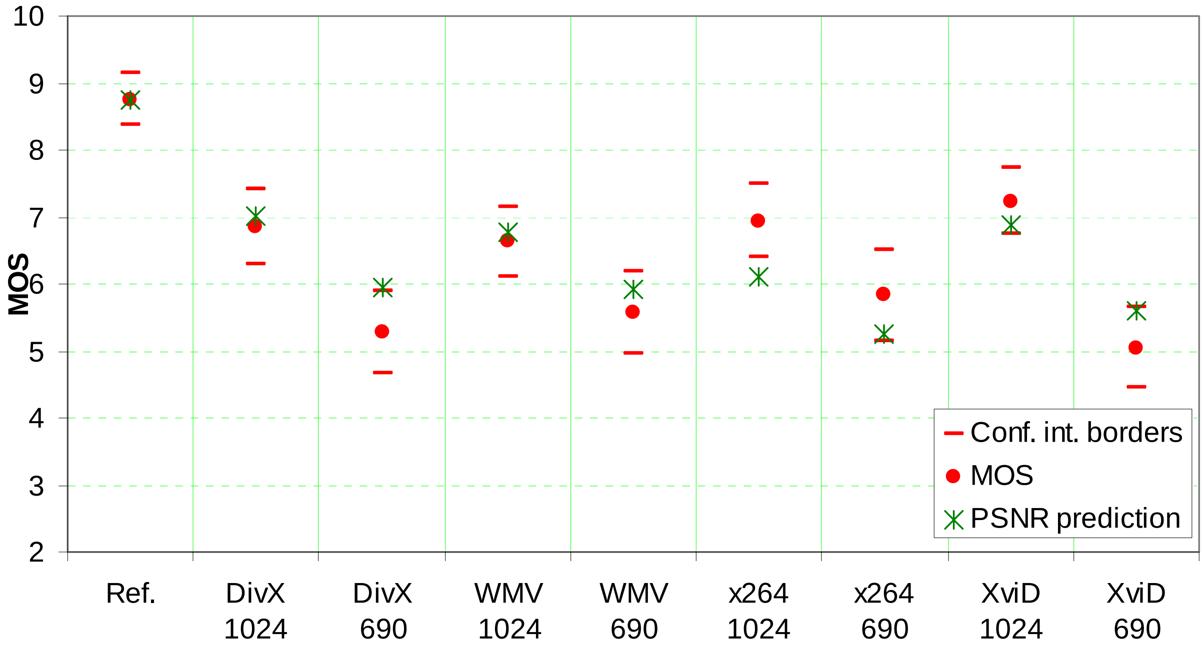


Picture 8. Rancho

All codecs performed equally well on the “Rancho” sequence, difference between the subjective ratings is small. x264 1024 is still the best, with mark equal to that of uncompressed sequence.

Rancho	Ref.	DivX 1024	DivX 690	WMV 1024	WMV 690	x264 1024	x264 690	XviD 1024	XviD 690
Ref.	1	0.94	1	0.96	1	0.51	0.91	0.83	1
DivX 1024	0.94	1	0.94	0.59	0.97	0.96	0.59	0.76	0.95
DivX 690	1	0.94	1	0.92	0.61	1	0.97	0.99	0.56
WMV 1024	0.96	0.59	0.92	1	0.96	0.98	0.68	0.83	0.93
WMV 690	1	0.97	0.61	0.96	1	1	0.98	1	0.54
x264 1024	0.51	0.96	1	0.98	1	1	0.94	0.87	1
x264 690	0.91	0.59	0.97	0.68	0.98	0.94	1	0.69	0.97
XviD 1024	0.83	0.76	0.99	0.83	1	0.87	0.69	1	0.99
XviD 690	1	0.95	0.56	0.93	0.54	1	0.97	0.99	1

Matrix sc.1

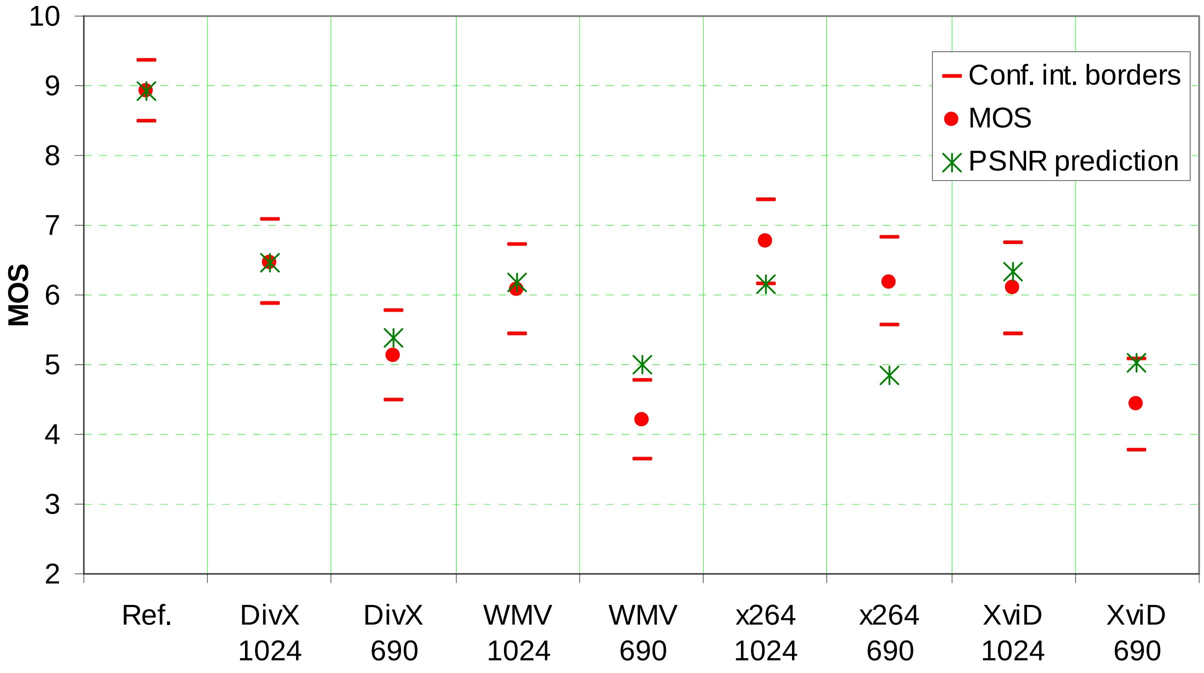


Picture 9. Matrix sc.1

XviD on 1024 kbps became a leader on this sequence, but its advantage is small. PSNR was adequate for this sequence except for x264 on 1024 kbps

Matrix sc.1	Ref.	DivX 1024	DivX 690	WMV 1024	WMV 690	x264 1024	x264 690	XviD 1024	XviD 690
Ref.	1	1	1	1	1	1	1	1	1
DivX 1024	1	1	1	0.71	1	0.6	0.99	0.85	1
DivX 690	1	1	1	1	0.74	1	0.88	1	0.7
WMV 1024	1	0.71	1	1	1	0.79	0.97	0.95	1
WMV 690	1	1	0.74	1	1	1	0.71	1	0.88
x264 1024	1	0.6	1	0.79	1	1	0.99	0.78	1
x264 690	1	0.99	0.88	0.97	0.71	0.99	1	1	0.95
XviD 1024	1	0.85	1	0.95	1	0.78	1	1	1
XviD 690	1	1	0.7	1	0.88	1	0.95	1	1

Matrix sc.2



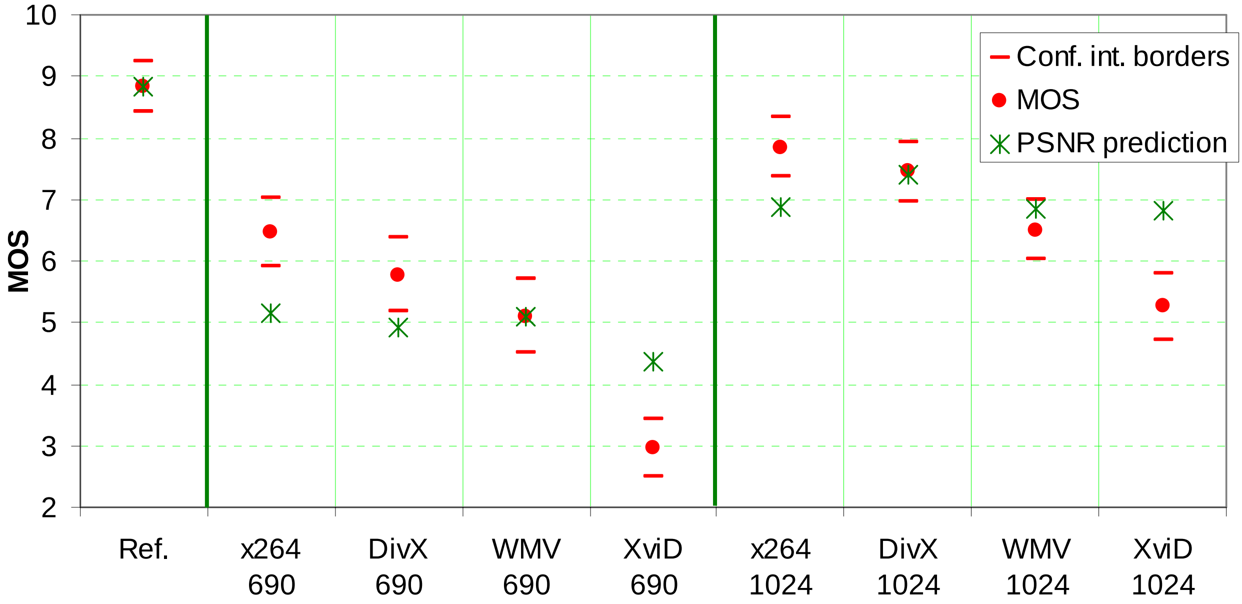
Picture 10. Matrix sc.2

x264 is the best again. PSNR values are close for DivX, WMV, x264 and XviD despite the fact that subjective scores differ.

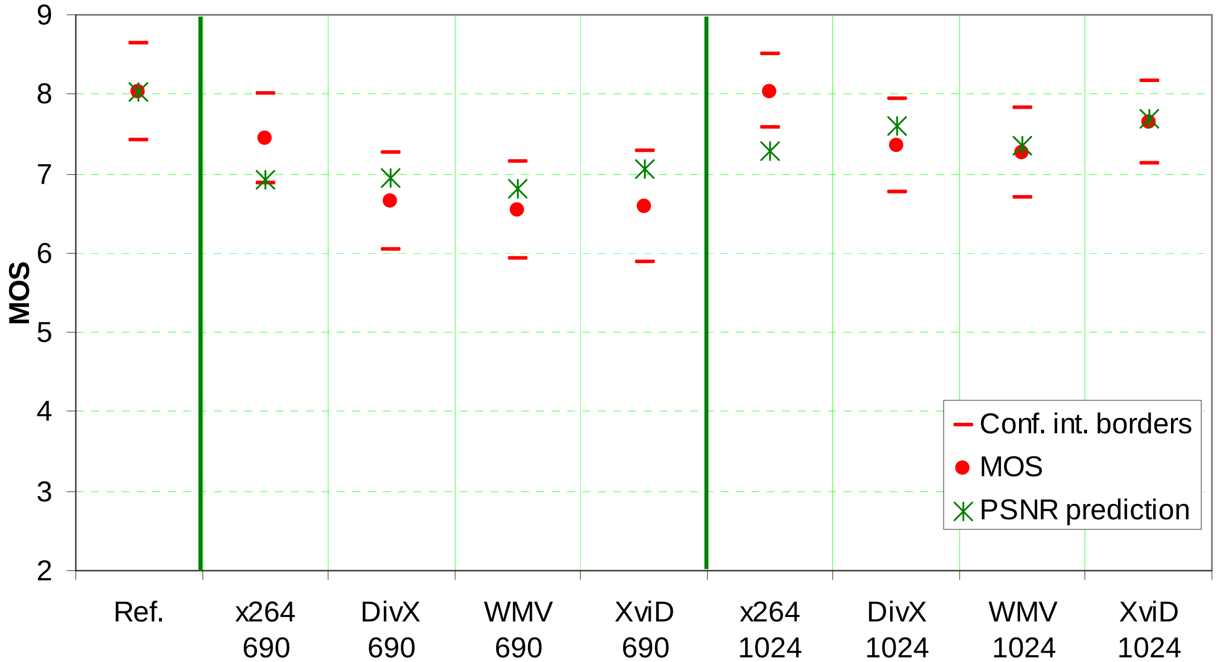
Matrix sc.2	Ref.	DivX 1024	DivX 690	WMV 1024	WMV 690	x264 1024	x264 690	XviD 1024	XviD 690
Ref.	1	1	1	1	1	1	1	1	1
DivX 1024	1	1	1	0.82	1	0.75	0.74	0.8	1
DivX 690	1	1	1	0.98	0.98	1	0.99	0.98	0.94
WMV 1024	1	0.82	0.98	1	1	0.94	0.6	0.52	1
WMV 690	1	1	0.98	1	1	1	1	1	0.69
x264 1024	1	0.75	1	0.94	1	1	0.9	0.93	1
x264 690	1	0.74	0.99	0.6	1	0.9	1	0.58	1
XviD 1024	1	0.8	0.98	0.52	1	0.93	0.58	1	1
XviD 690	1	1	0.94	1	0.69	1	1	1	1

MOS+PSNR graphs, grouped by bitrate

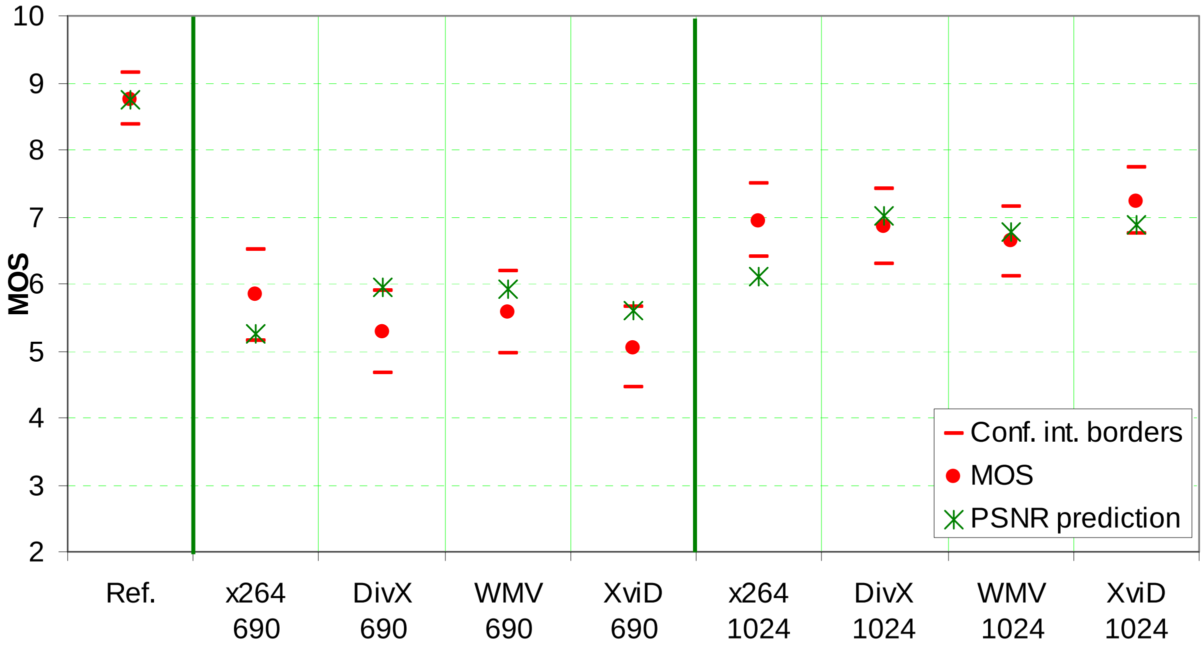
To ease evaluation of codecs on different bitrates separately, we provide same graphs as in the previous paragraph except MOS results are grouped by bitrate.



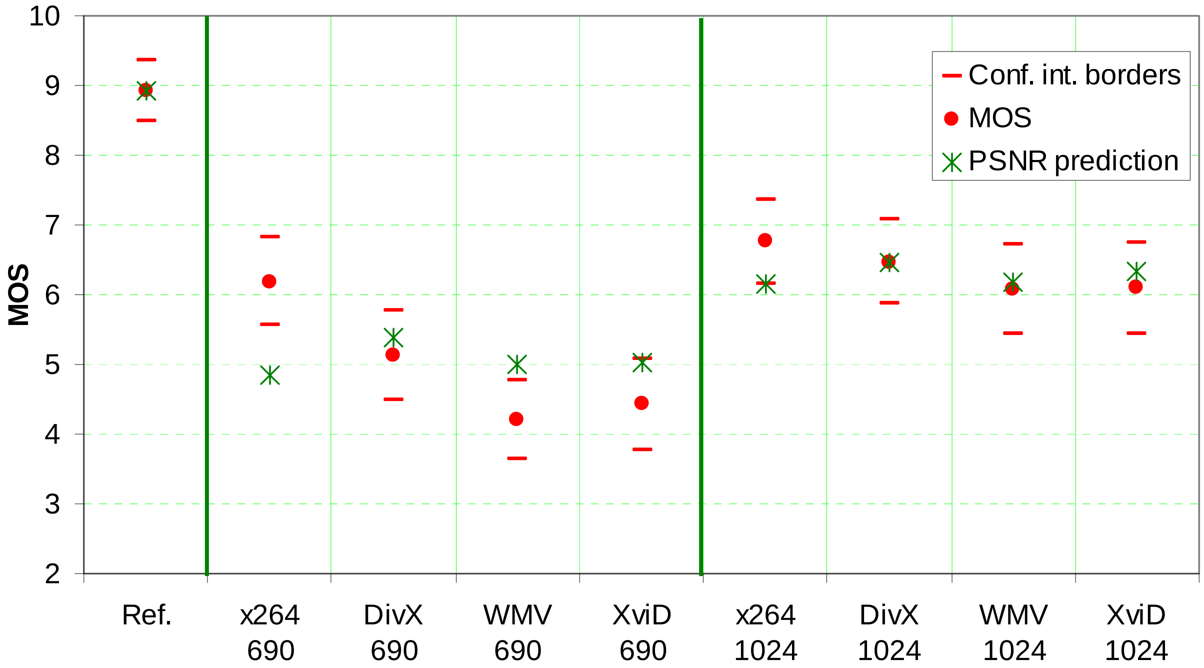
Picture 11. Battle



Picture 12. Rancho



Picture 13. Matrix sc.1

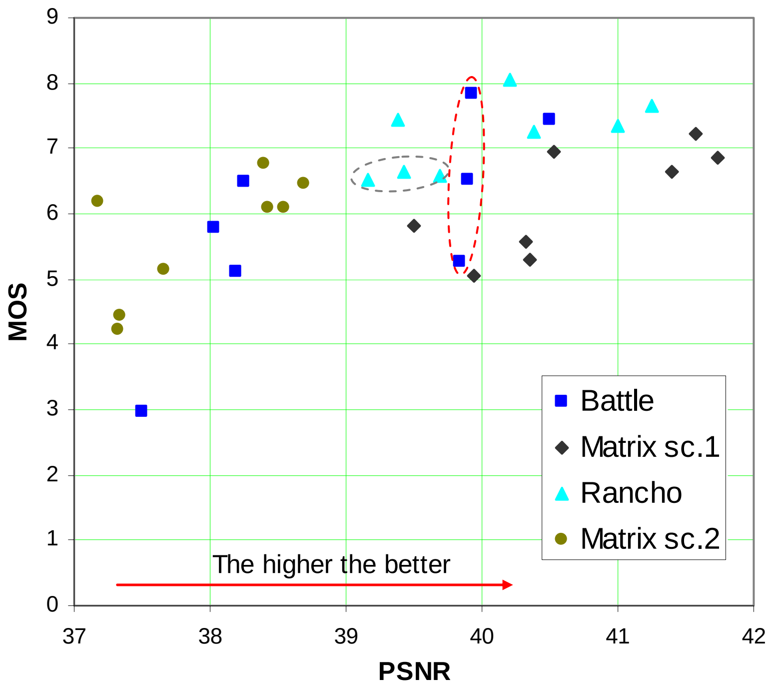


Picture 14. Matrix sc.2

Correlation of objective metrics and subjective scores

Below you can see two types of graphs: first one is a value of subjective score plotted against a value of an objective metric[4].

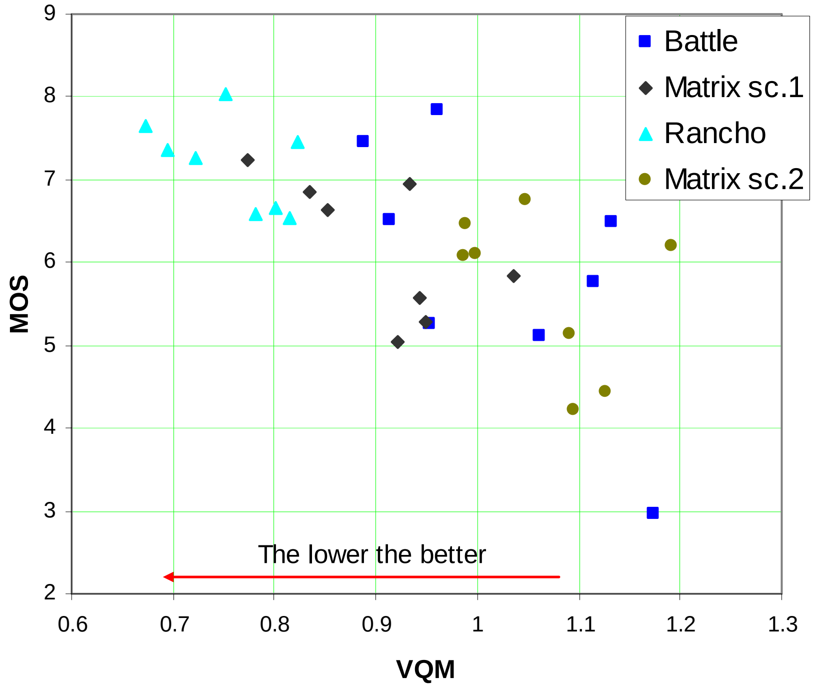
Such graphs must be treated separately for each sequence, because subjective scores are context-sensitive (subjective score for a sequence is given by an expert according to another versions of it). These graphs are plotted together for the ease of perception.



Picture 15. Relation between PSNR and MOS

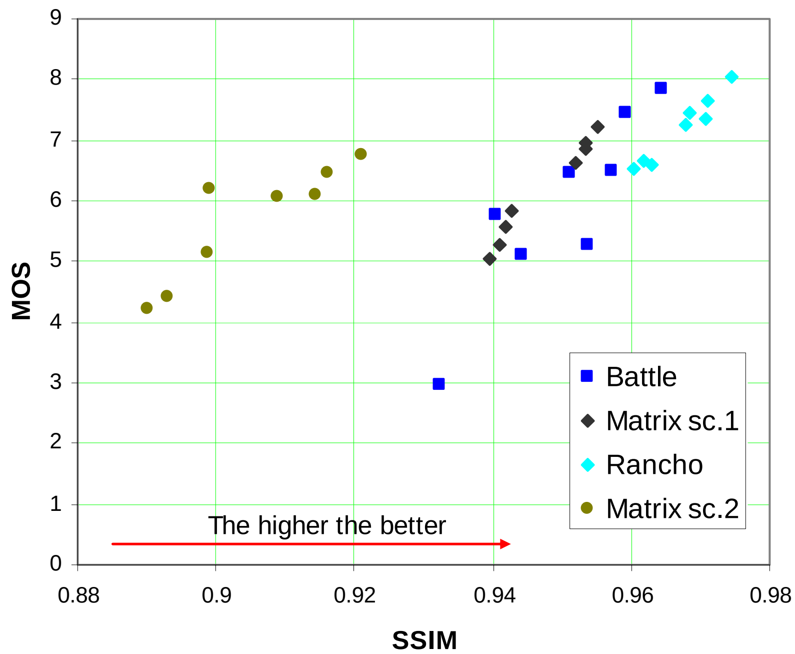
As you can see, PSNR reflection of perceived video quality is limited. Sometimes one value of PSNR corresponds to absolutely different subjective ratings for the same sequence (marked with red oval) and vice versa (marked with grey oval).

[4] PSNR, VQM and SSIM were measured with MSU Video Quality Measurement Tool[7]



Picture 16. Relation between VQM and MOS

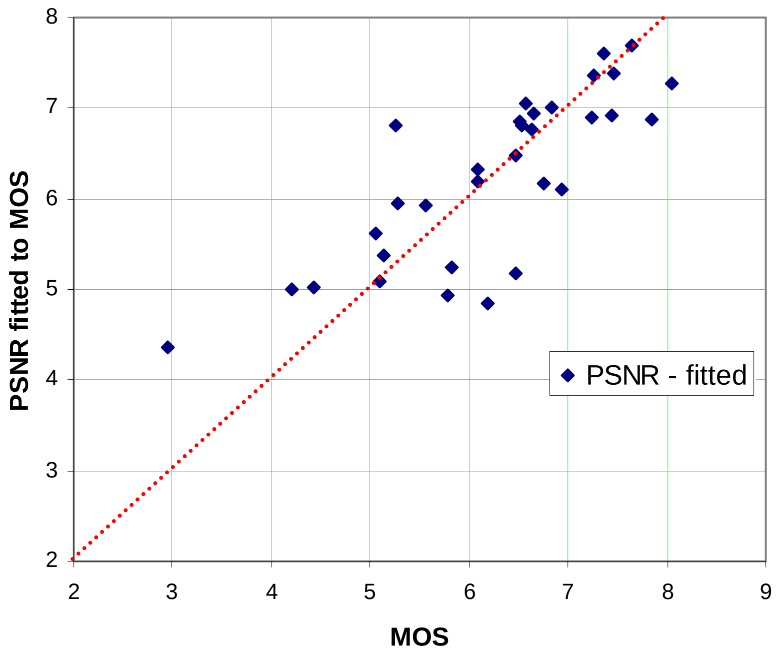
VQM produced prediction not better than PSNR on our test. Overall, quality is more or less predicted, but sometimes bad metric value corresponds to good perceived quality.



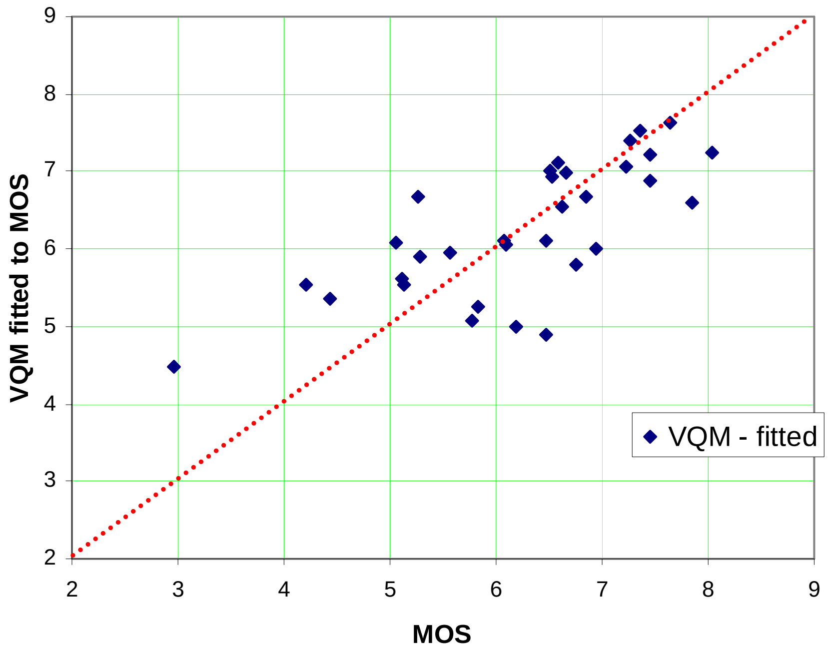
Picture 17. Relation between SSIM and MOS

SSIM predicts subjective opinion with high precision, its' data is close to straight line for each sequence.

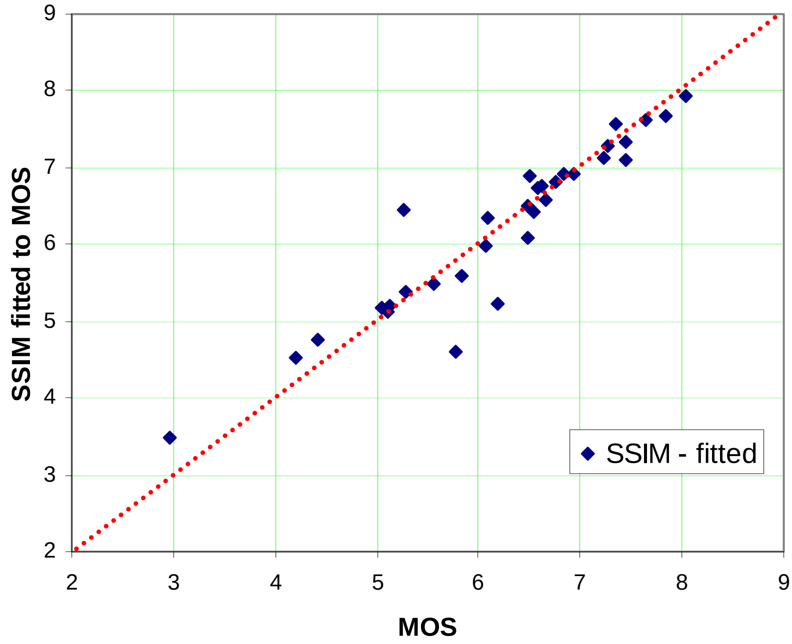
Second type of graphs – subjective mark predicted with objective metric plotted against real subjective mark. Predicted mark was obtained by applying the fitting function for each sequence separately. Prediction is good when fitted values of objective metric are close to the straight line.



Picture 18. PSNR fitted to MOS for each sequence



Picture 19. VQM fitted to MOS for each sequence



Picture 20. SSIM fitted to MOS for each sequence

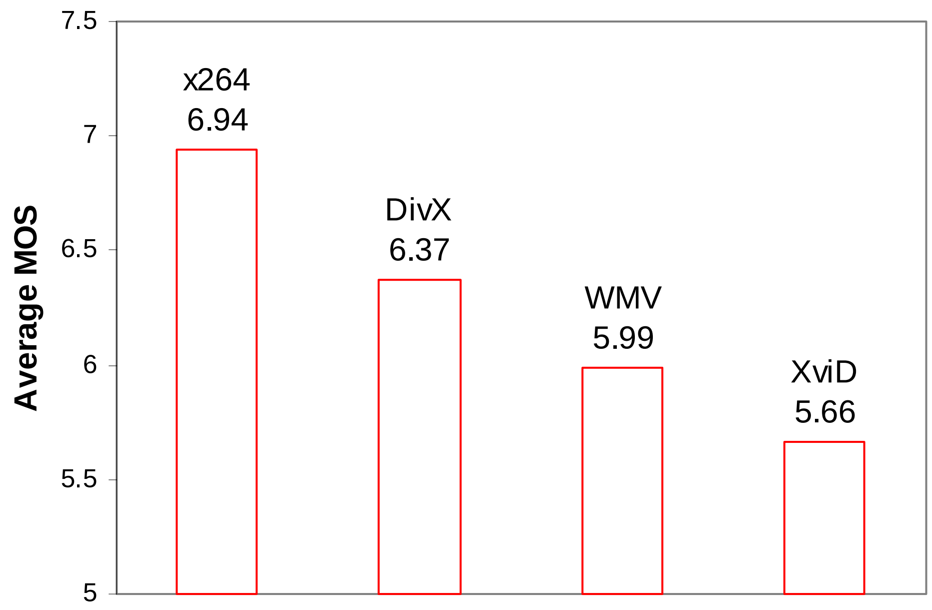
As you can see, PSNR and VQM provided prediction of similar quality on our test set, and it was quite poor, meanwhile SSIM reached prediction close to the ideal one.

To numerically evaluate prediction of the objective metrics, we calculated Pearson's correlation coefficient between objective marks (after applying the fitting function) and subjective ones. Correlation coefficient belongs to the segment from -1 to 1 and reflects degree of dependency between values (the higher the absolute value, the more powerful dependency is).

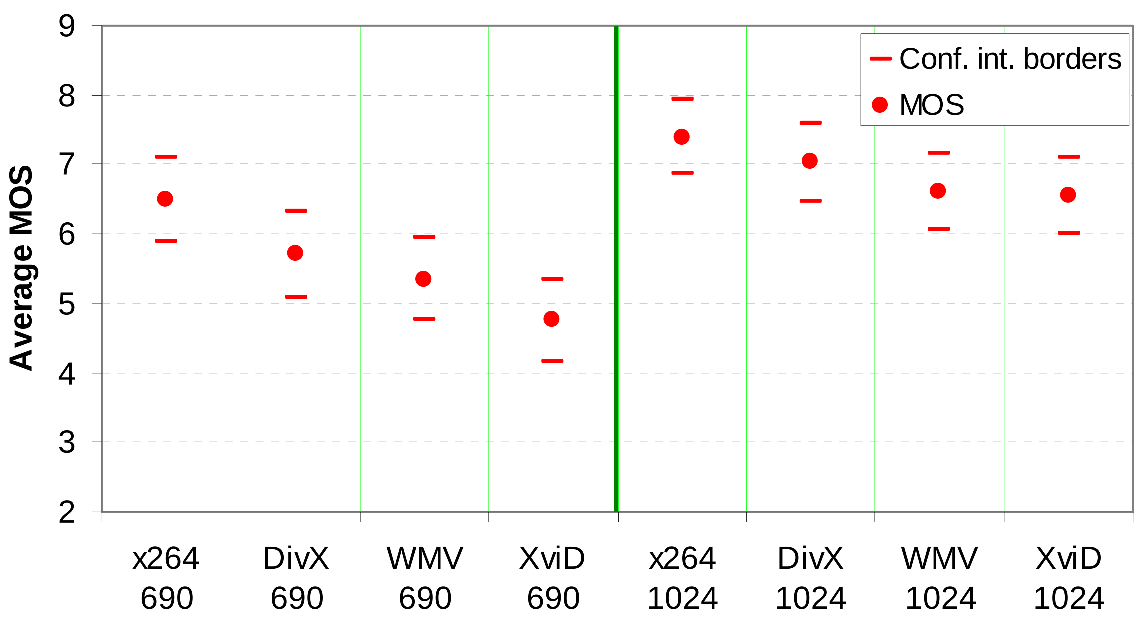
Metric	Correlation
PSNR	0.802
VQM	0.729
SSIM	0.937

Results of the comparison

Following graphs present MOS value for each codec after averaging among all sequences and all bitrates.



Picture 21. Average MOS for all codecs



Picture 22. Average MOS for all codecs and bitrates

Plots from previous part of report reflect average subjective opinion on codecs. To calculate rank of each codec on the whole test set, we apply following method: count rank of codec for each sequence and then count sum of ranks ("Overall" row). Sorting this array we get rank of codec in comparison (Ref. - uncompressed sequence, was evaluated by experts as well as others).

	Battle	Rancho	Matrix sc.1	Matrix sc.2	Overall	**Place**
Ref.	1	1	2	1	5	**-**
x264 1024	2	3	1	2	8	**1**
DivX 1024	3	4	5	3	15	**2**
XviD 1024	7	2	3	5	17	**3**
x264 690	5	6	4	4	19	**4**
WMV 1024	4	5	6	6	21	**5**
DivX 690	6	8	7	7	28	**6**
WMV 690	8	7	9	9	33	**7**
XviD 690	9	9	8	8	34	**8**

x264 supremacy is obvious for both 690 kbps and 1024 kbps, it is interesting that its' average mark for 690 kbps is better than the mark of WMV on 1024 kbps. DivX is the second, and WMV and XviD are last. Last place of XviD can be explained by the lack of deblocking during the assessment.

Conclusions

- Open source x264 codec of the new H.264 compression standard was found out to be better than long-developed proprietary solutions.
- Subjective comparison is stable and productive method for video systems' assessment when all testing conditions are precisely adhered to.
- Subjective tests can not always be replaced by objective ones with sufficient precision. SSIM was the best objective metric in our comparison.

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8. M.H. Prinson, S. Wolf, “The Impact of Monitor Resolution and Type on Subjective Video Quality Testing”, NTIA TM-04-412
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About us (Graphics & Media Lab Video Group)

GRAPHICS & MEDIA LAB
VIDEO GROUP

Graphics & Media Lab Video Group is a part of Graphics & Media Lab of Computer Science Department in Moscow State University. The history of Graphics Group began at the end of 1980's. Graphics & Media Lab was officially founded in 1998. Main research directions of the lab lie in different areas of Computer Graphics, Computer Vision and Media Processing (audio, image and video processing). Some of research results were patented, other results were presented in a number of publications.

Main research directions of Graphics & Media Lab Video Group are video processing (pre-, post- and video analysis filters) and video compression (codecs' testing and tuning, quality metrics research, development of codecs).

Our main achievements in **video processing:**

- High quality industrial filters for format conversion including high quality deinterlacing, high quality frame rate conversion, new fast practical super resolution, etc.
- Methods for modern TV-sets: big family of up-sampling methods, smart brightness and contrast control, smart sharpening, etc.
- Artifacts' removal methods: family of denoising methods, flicking removal, video stabilization with frame edges restoration, scratches, spots, drop-outs removal, etc.
- Specific methods like: subtitles removal, construction of panorama image from video, video to high quality photo, video watermarking, video segmentation, practical fast video deblur, etc.

Our main achievements in **video compression:**

- Well-known public comparisons of JPEG, JPEG-2000, MPEG-2 decoders, MPEG-4 and annual H.264 codec's testing; also we provide tests for "weak and strong points of codec X" for companies with bugreports and codec tuning recommendations.
- Our own video quality metrics research, public part is MSU Video Quality Measurement Tool and MSU Perceptual Video Quality Tool.
- We have internal research and contracts on modern video compression and publish our MSU Lossless Video Codec and MSU Screen Capture Video Codec – codecs with ones of the highest compression ratios.

We are really glad to work many years with companies like Intel, Samsung, RealNetworks and others.

A mutual collaboration in areas of video processing and video compression is always interesting for us.
E-mail: video@graphics.cs.msu.ru

MSU Video Quality Measurement Tool

MSU Graphics & Media Lab. Video Group.

GRAPHICS & MEDIA LAB
VIDEO GROUP

Main Features

1. 12 Objective Metric + 5 Plugins

PSNR several versions,
MSAD,
Delta,
MSE,
SSIM Fast,
SSIM Precise,
VQM,

MSU Blurring Metric,
MSU Brightness Flicking Metric,
MSU Brightness Independent PSNR,
MSU Drop Frame Metric,
MSU Noise Estimation Metric,
MSU Scene Change Detector,
MSU Blocking Metric.

2. More Than 30 Supported Formats, Extended Color Depth Support

*.AVI,
*. YUV:
YUV,
YV12,
IYUV,
UYVY,
Y,
YUY2,
*.BMP,

*.AVS:
*.MOV,
*.VOB,
*.WMV,
*.MP4,
*.MPG,
*.MKV,
*.FLV,
etc.,

Extended Color Depth:
P010, P014,
P016, P210,
P214, P216,
P410, P414,
P416,
P410_RGB,
P414_RGB,
P416_RGB.

3. Multi-core Processors Support

MMX, SSE and OpenMP Optimizations

4. Comparative Analysis

Comparison of 3 files at a time

5. ROI Support

Metric calculation for ROI (Region of Interest)

6. GUI & Batch Processing

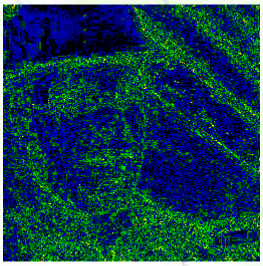
GUI and command line tools

7. Plugins Interface

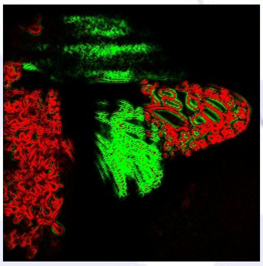
You can easily develop your own metric

Visualization Examples

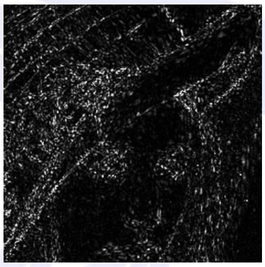
Allows easily detect where codec/filter fails

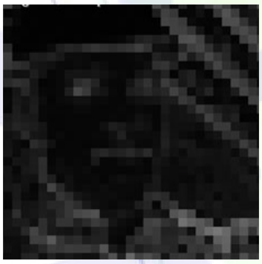

Y-YUV PSNR


Y-YUV Delta


MSU Blurring Metric


MSU Blocking Metric


Y-YUV MSE


VQM

8. Universal Format of Results

Results are saved in *.csv files

9. HDTV Support

10. Open-Source Plugins Available

11. Metric Visualization

Fast problem analysis, see examples above.

http://www.compression.ru/video/quality_measure/index_en.html

Tool was downloaded more than 100 000 times!

Free and Professional versions are available

Big thanks to our contributors:

Apple Inc.