

**GRAPHICS & MEDIA LAB  
VIDEO GROUP**

# **Windows Media Photo and JPEG 2000 Codecs Comparison**

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## Table of contents

Overview.....	3
Goals and rules of testing.....	4
WMPHoto codecs testing goal .....	4
Rules of the testing .....	4
WMPHoto settings.....	4
Images used in the testing.....	5
Impact of parameter values on image quality.....	6
Y-PSNR/Compressed file size, Delta-Y-PSNR/Compressed file size diagrams .....	8
Barbara image.....	9
Lenna image .....	10
Lighthouse image.....	11
House image .....	12
PSNR comparison conclusions .....	13
Visual comparison .....	14
WMPHoto vs JPEG 2000 .....	14
Visual comparison conclusions.....	18
Informal codecs comparison.....	19
Informal comparison rules.....	19
Informal comparison results.....	19
General conclusions .....	20
Acknowledgements .....	21
Appendix 1: JPEG 2000 codecs description .....	22
Codecs .....	22
Codecs' settings.....	22
Appendix 2: Detailed images description .....	23
Images properties .....	23
Barbara .....	23
Lenna .....	24
Lighthouse.....	25
House.....	26

## Overview

Demand for effective image compression has been growing for many decades already, especially after rapid development of digital photo technology. Nowadays it can be said that most of digital images in the world are stored in JPEG format. This format was approved by ISO in 1994 and has already become outdated due to the tremendous increase of computational power of end-user devices and development of more effective algorithms.

One of potential “JPEG killers” is JPEG 2000 that offers much better quality/size ratio, but unfortunately it has not been actively supported by hardware and software manufacturers. Microsoft recently released specification of its new format WMPPhoto (Windows Media Photo) that is claimed to “significantly improve end-to-end digital imaging”. This comparison was done to assess this statement.

## Goals and rules of testing

### WMPHoto codecs testing goal

It has been stated by Microsoft that WMPHoto offers better compression quality than that of current standards, and even than relatively new JPEG 2000 (see [WinHEC 2006 presentation](#)). **In this comparison the Microsoft's new development is compared against nine one-year old versions of JPEG 2000 codecs.** Only compression quality was compared. Codecs have been tested on standard test images, for JPEG 2000 all codecs settings were set to default except for compressed image quality (for more details see [Appendix 1](#)).

JPEG standard is not evaluated in this comparison, because both JPEG 2000 and WMPHoto significantly outperform it. To evaluate their superiority, please refer to last year's [MSU JPEG 2000 Image Codecs Comparison](#) that includes JPEG.

### Rules of the testing

- PSNR was calculated using PRO version of [MSU Video Quality Measurement Tool 1.2](#).
- Compressed image quality for JPEG 2000 and WMPHoto was chosen to get approximately same range of output file sizes for all codecs.
- Only "quality" parameter was varied for JPEG 2000 codecs. For WMPHoto "quality" and "overlapping" parameter were changed.

### WMPHoto settings

We have used tools "wmpencapp.exe" and "wmpdecapp" kindly provided by Bill Crow in [his blog](#). For all test pictures, we have used the following values for its parameters:

Parameter	Values
-l, "overlapping"	0, 1, 2
-q, "quality"	2, 7, 12, 17, 22, 27, 32, 37, 42, 47, 52, 57, 62, 67, 72, 77

## **Images used in the testing**

We have used four real-world images that are usually used in comparisons of image processing algorithms. All of them have dimensions of 512x512 pixels and uncompressed size is 786486 bytes. For more details, see [Appendix 2](#).

## Impact of parameter values on image quality

In our test we varied only two parameters, quality and overlapping. Usage of quality parameter is very simple: its' range is from 1 to 255, the higher the value the lower the quality (this interpretation seems a bit odd). Below there is an example of how quality parameter affects visual impression (overlapping is set to level 2).



q = 22



q = 62



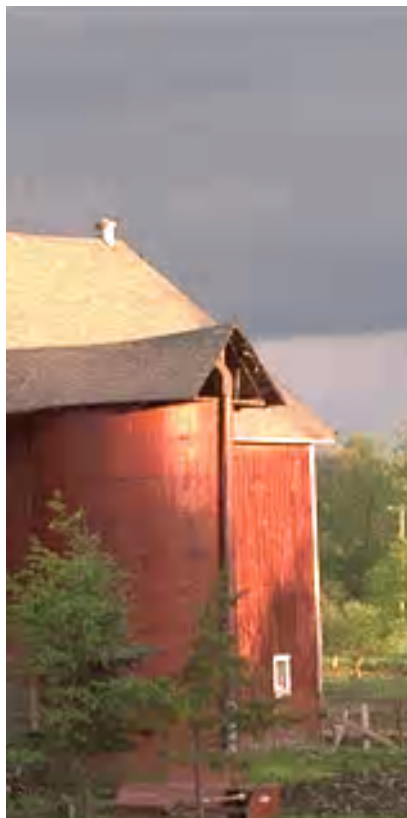
q = 72

### Lighthouse.bmp compressed with different quality values

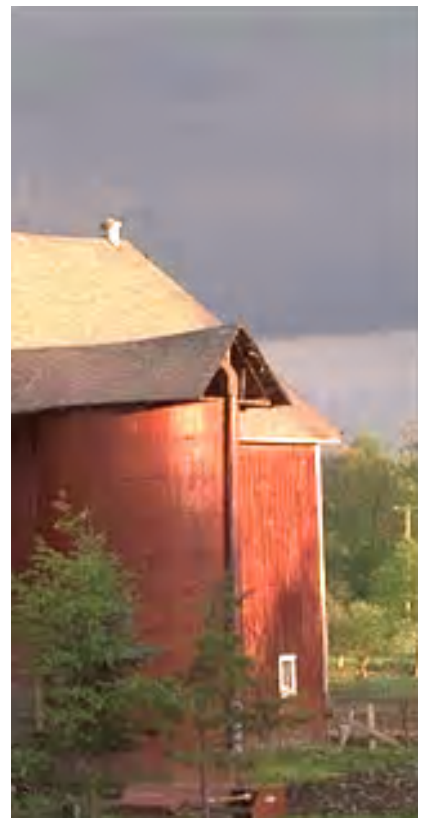
Overlapping is another parameter that affects image quality. It has only three values: 0 – no overlapping (lots of blocks in decompressed image), 1 – one level overlapping (blocks are less noticeable) and 2 – two level overlapping (image is blurred). Below there are examples of images with different overlapping values (q=57).



$l = 0$



$l = 1$



$l = 2$

**House.bmp compressed with different overlapping values**

## Y-PSNR/Compressed file size, Delta-Y-PSNR/Compressed file size diagrams

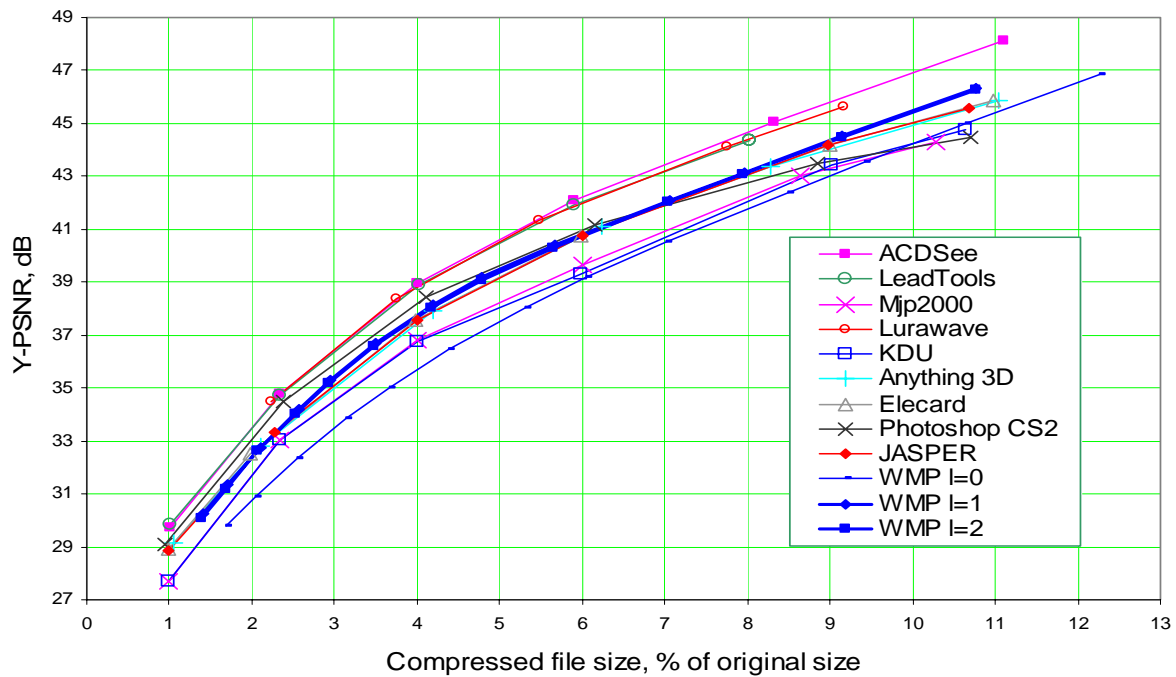
These diagrams clearly show the dependency of the compression quality from compression (size of compressed file divided by size of uncompressed file). PSNR metric is used for quality evaluation.

**The higher level of PSNR measure (height of graphs) means better quality.**

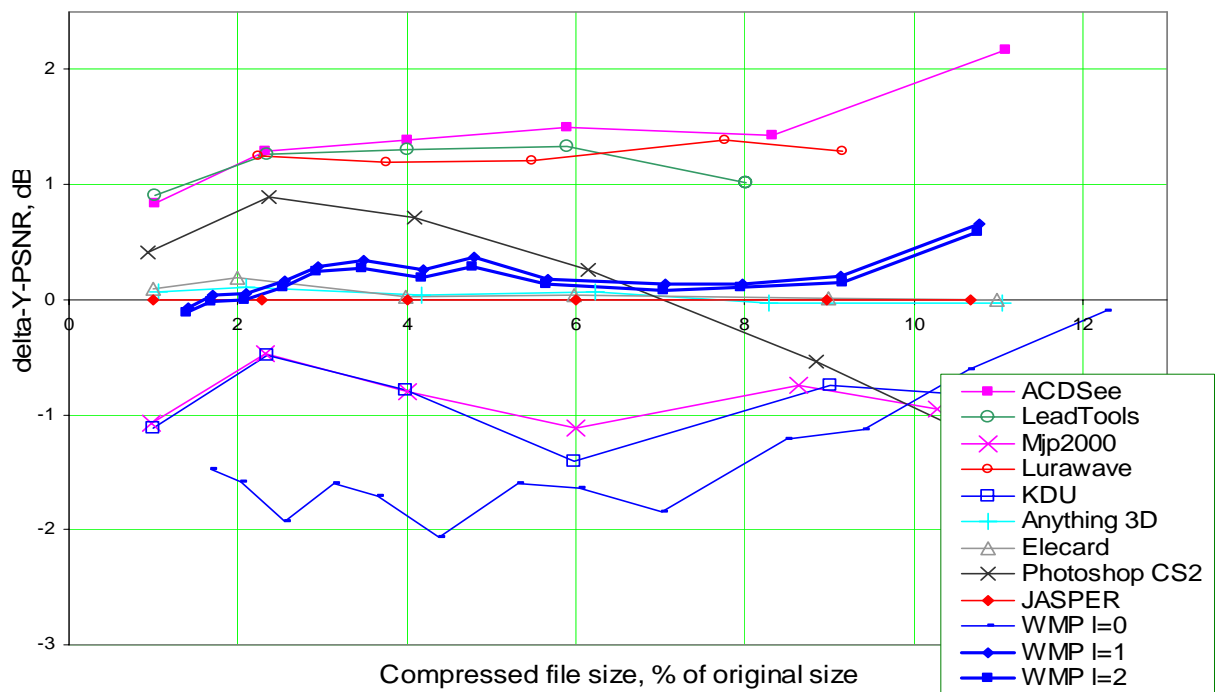
Delta Y-PSNR is the diagram of comparative PSNR value. JASPER is included in JPEG 2000 standard as a reference implementation of the standard, it corresponds to 0 on delta-PSNR graphs. PSNR values for JASPER are linearly interpolated to obtain values that correspond to any compressed file size and then subtracted from PSNR values of other codecs.



**Barbara image**



**Picture 1. Y-PSNR, Barbara**



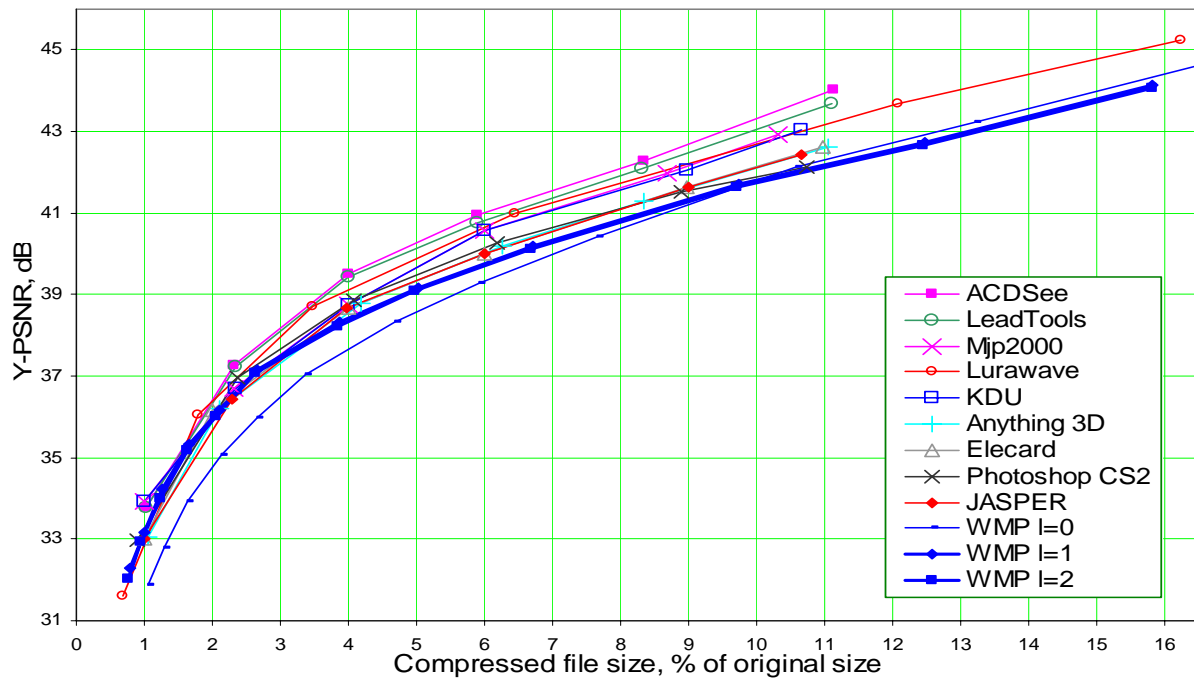
**Picture 2. Delta-Y-PSNR, Barbara**

**Conclusions:**

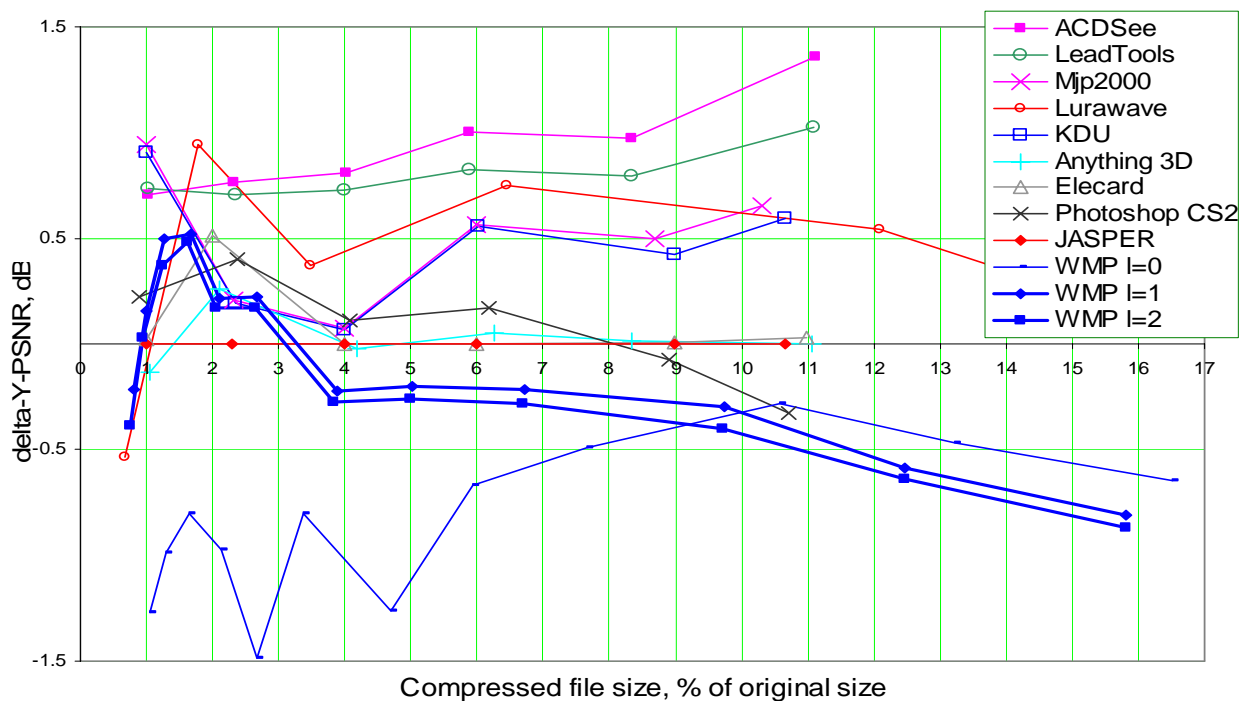
- On this picture WMPHoto is only slightly better than the reference JPEG 2000 implementation and is outperformed by ACDSee, Lurawave and LeadTools codecs.

- Various values of “-l” parameter affect objective metric as well as visual quality.

**Lenna image**



**Picture 3. Y-PSNR, Lenna**



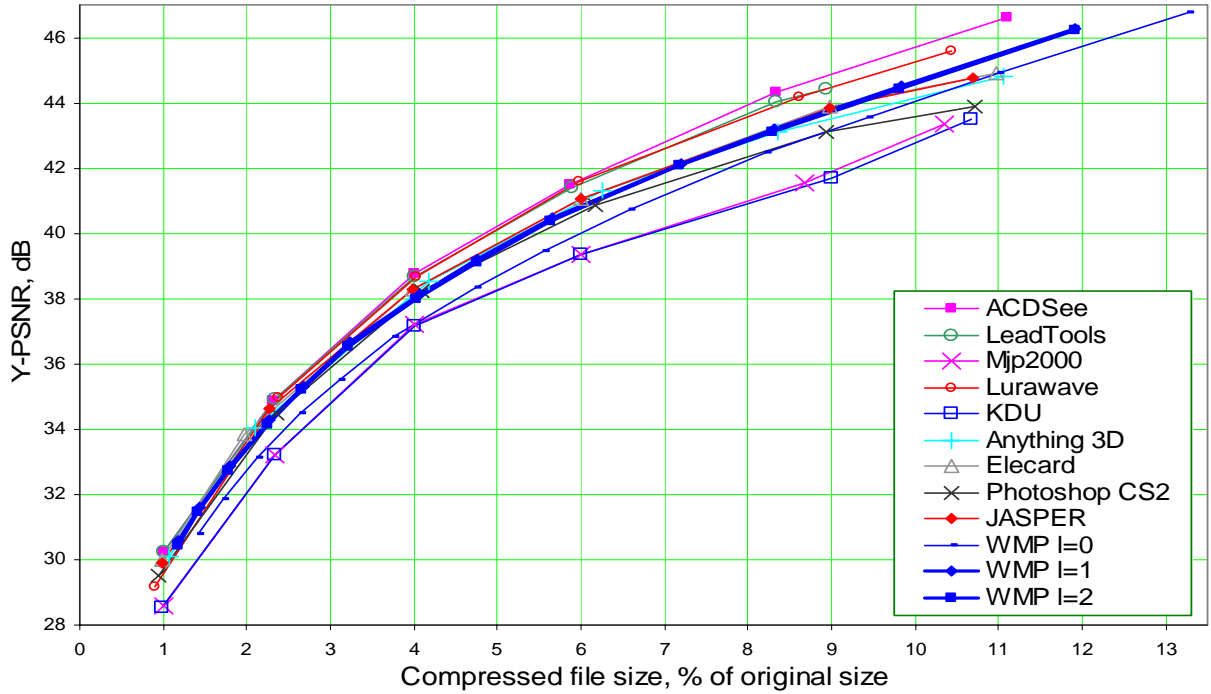
**Picture 4. Delta-Y-PSNR, Lenna**

**Conclusions:**

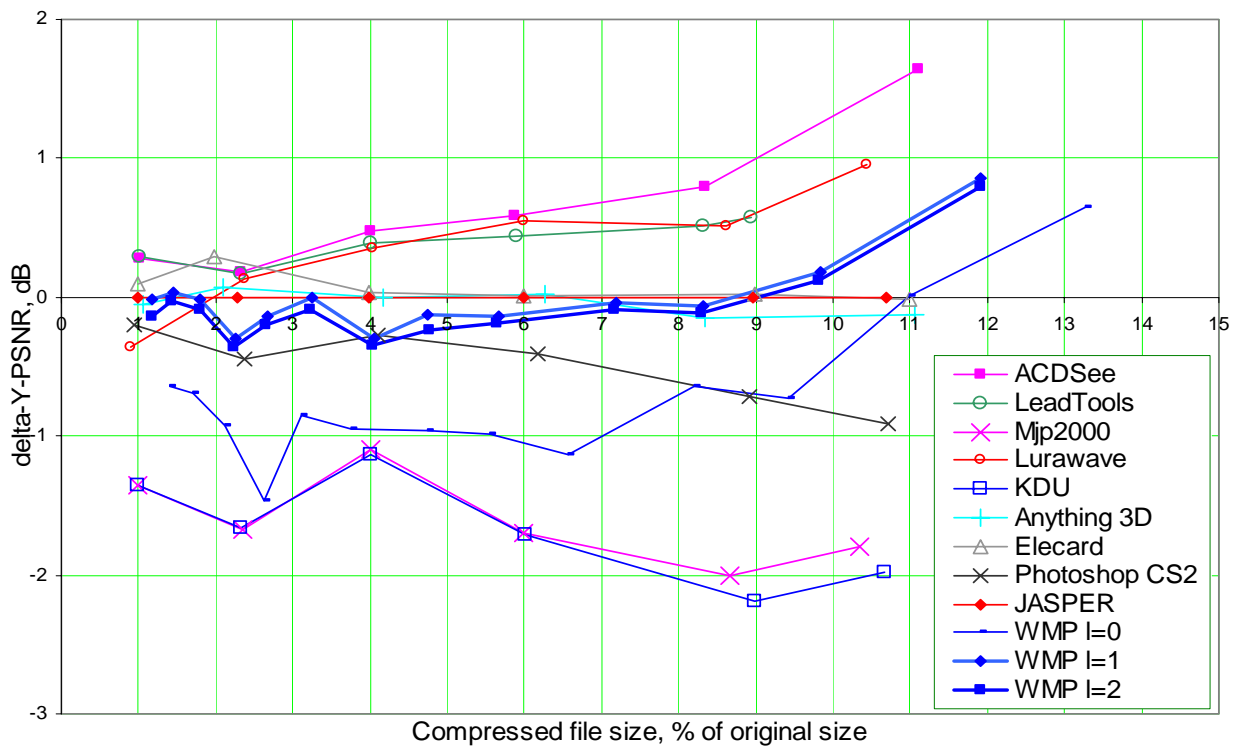
- It is hard to define a leader on high compression, but it is definitely not WMPphoto.

- WMPHoto is the worst on high compression rates.

**Lighthouse image**



**Picture 5. Y-PSNR, Lighthouse**

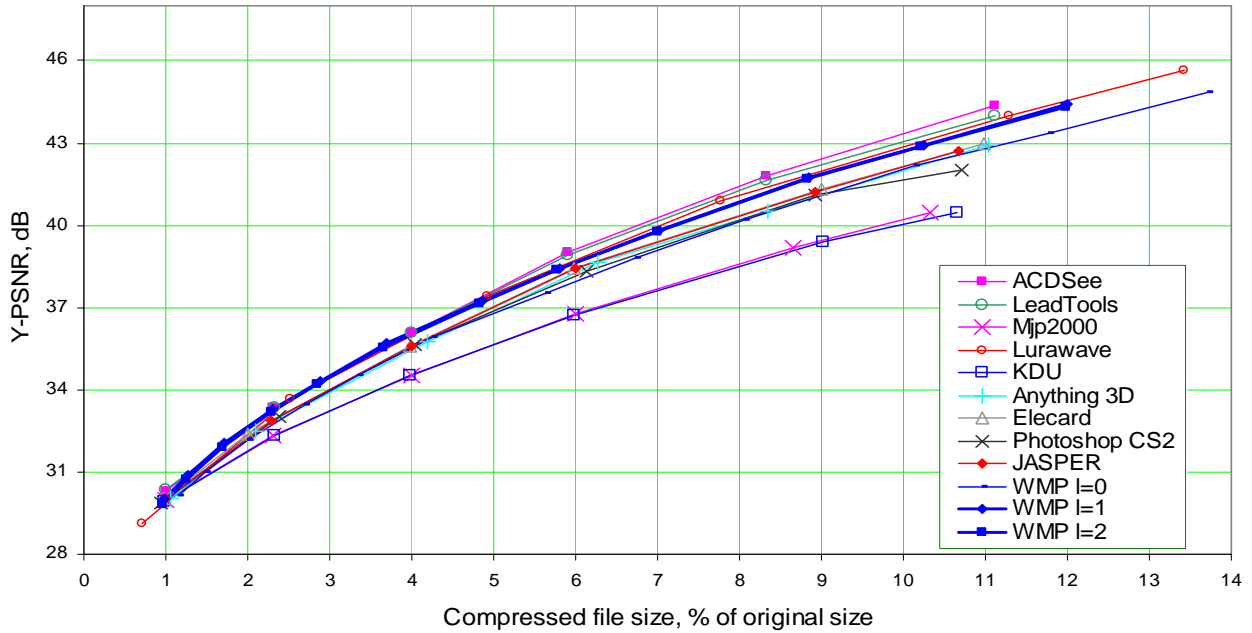


**Picture 6. Delta-Y-PSNR, Lighthouse**

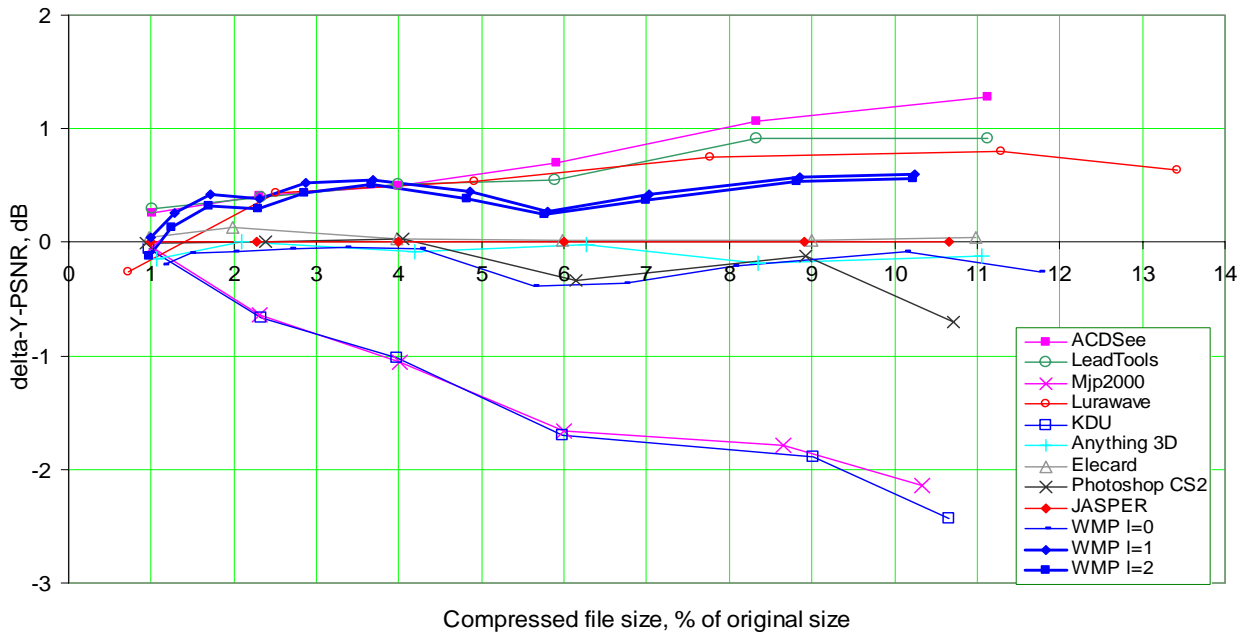
**Conclusions:**

- WMPHoto shows average results on this picture.

**House image**



**Picture 7. Y-PSNR, House**



**Picture 8. Delta-Y-PSNR, House**

**Conclusions:**

- This is the only picture on which WMPHoto outperforms all JPEG 2000 codecs in a number of points.

### **PSNR comparison conclusions**

As one can see on graphs above, WMPHoto is not better than JPEG 2000 codecs according to PSNR measure, although it was stated that its average PSNR is 2 dB higher. It performs better than most of other codecs only on House image.

## Visual comparison

### WMPHOTO vs JPEG 2000

Difference in Y-PSNR values between WMPHOTO and best JPEG 2000 codec is up to 2 dB. With visual comparison we can check how this data corresponds to real visual quality. F is 'Barbara' test image, compressed 50 times.



WMPHOTO, 16311 bytes



Photoshop CS2, 18669 bytes



ACDSee, 18324 bytes



Lurawave, 17648 bytes



Morgan JPEG 2000, 18368 bytes



KDU\_compress, 18402 bytes



Anything 3D, 16492 bytes



Leadtools, 18387 bytes



Elecard, 15611 bytes

As you can see, WMPHoto introduces blocking artifacts in nose area and lines on neckerchief look less sharp than on other images. Plus of WMPHoto is that it has no aliasing artifact that some JPEG 2000 implementations have.

With JPEG 2000 and WMPHoto it is possible to operate at very high compression ratios. Following image 'Lighthouse' was compressed 100 times.



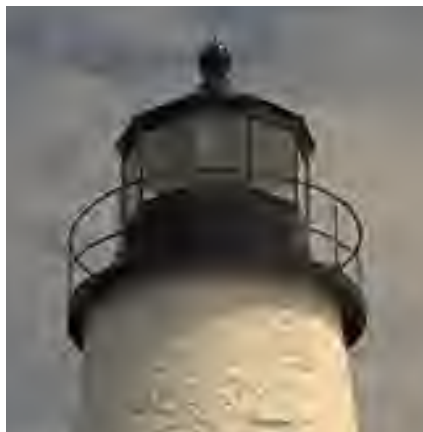
**WMPHoto, 9227 bytes**



**Photoshop CS2, 7372 bytes**



**ACDSee, 7989 bytes**



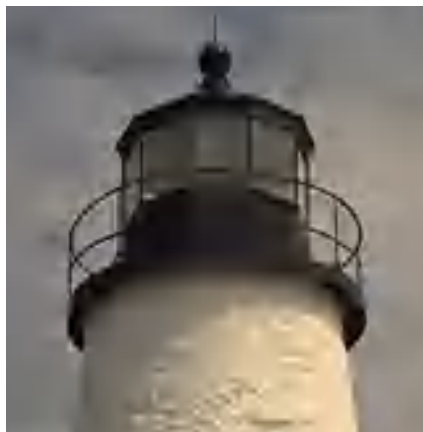
**Lurawave, 7016 bytes**



**Morgan JPEG2000, 7864 bytes**



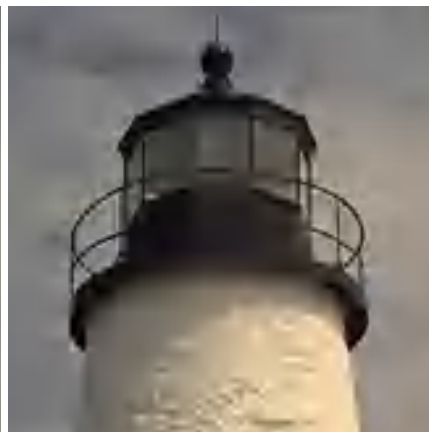
**KDU\_compress, 7804 bytes**



**Anything 3D, 8349 bytes**



**Leadtools, 7942 bytes**



**Elecard, 7815 bytes**

On 'Lighthouse' image visual quality of WMPHoto is very similar to that of JPEG 2000 codecs.

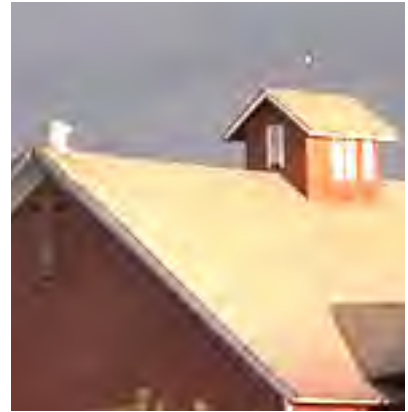
This is a part of test image 'House', compressed 100 times.



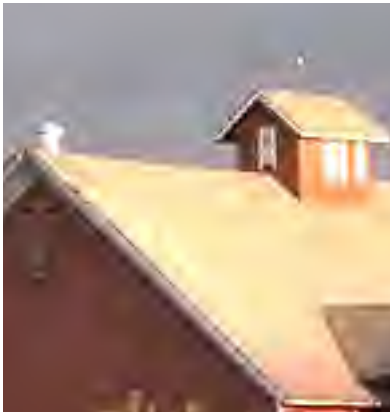
**WMPHOTO, 7636 bytes**



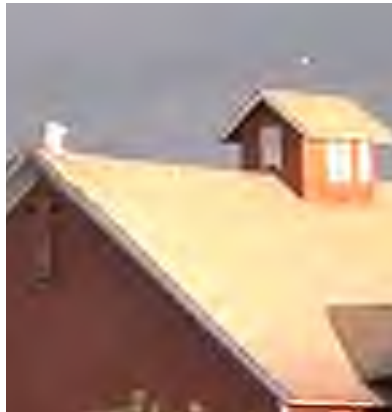
**Photoshop CS2, 7363 bytes**



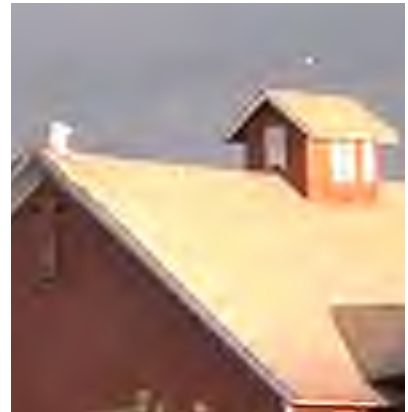
**ACDSee, 7925 bytes**



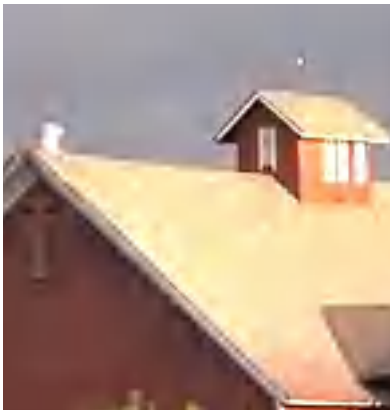
**Lurawave, 5651 bytes**



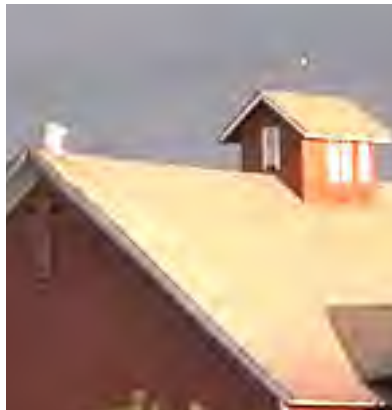
**Morgan JPEG2000, 7938 bytes**



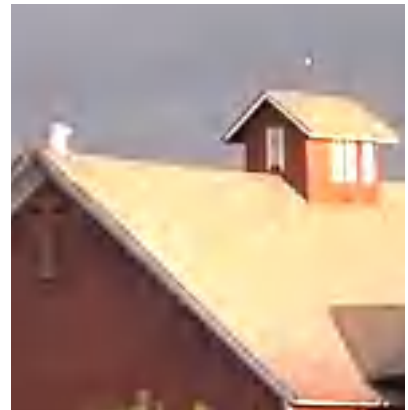
**KDU\_compress, 7682 bytes**



**Anything 3D, 8337 bytes**



**Leadtools, 7919 bytes**

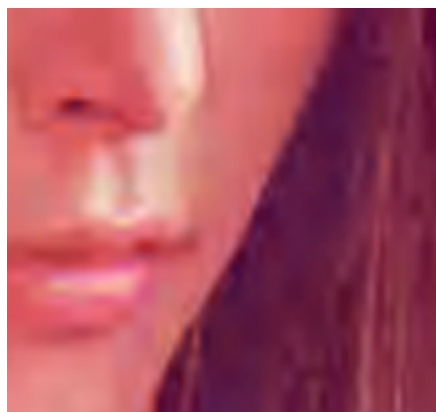


**Elecard, 7664 bytes**

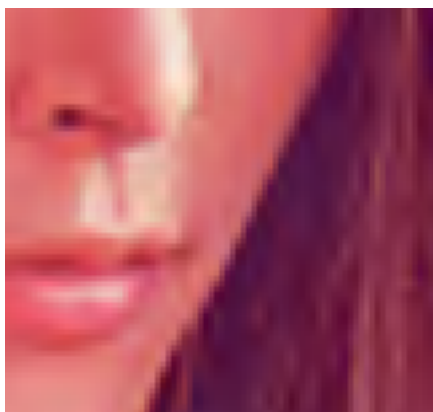
On 'House' image WMPHOTO shows visual quality that is among the best JPEG 2000 codecs. This achievement is confirmed with high PSNR values on this picture.

This is a part of test image 'Lenna', compressed 100 times. Fragment is two times enlarged.

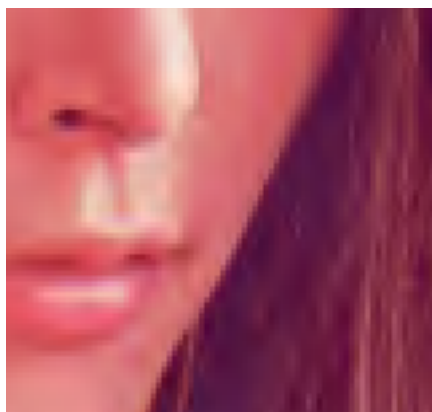




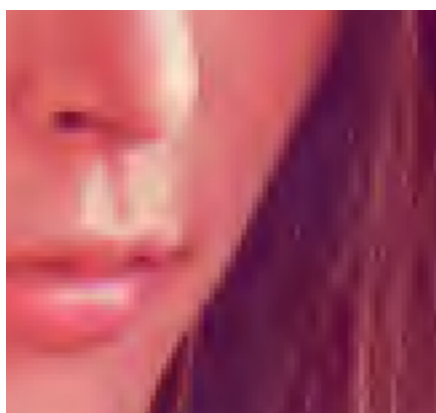
**WMPHOTO, 16185 bytes**



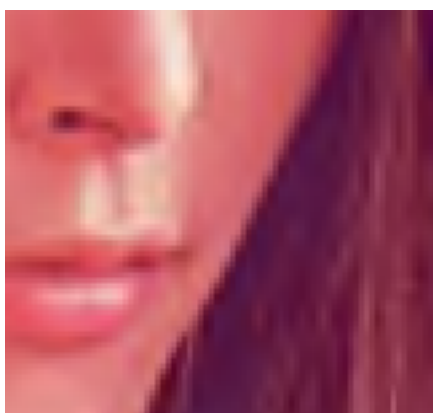
**Photoshop CS2, 18642 bytes**



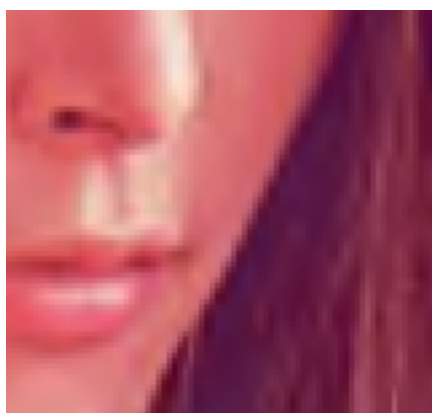
**ACDSee, 18291 bytes**



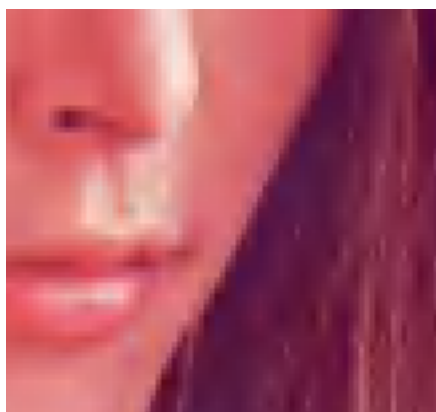
**Lurawave, 14038 bytes**



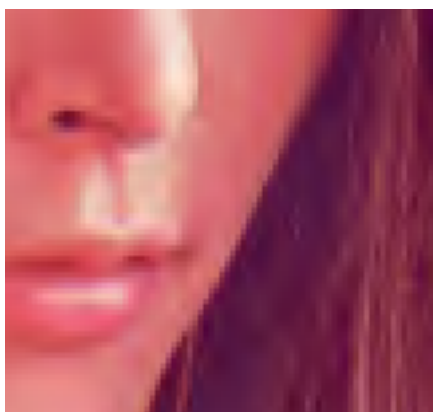
**Morgan JPEG2000, 18285 bytes**



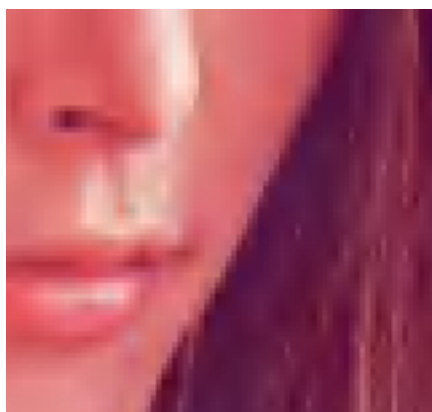
**KDU\_compress, 18395 bytes**



**Anything 3D, 16507 bytes**



**Leadtools, 18403 bytes**



**Elecard, 15677 bytes**

On this image WMPHOTO introduces significant artifact on border between face and hair. Blocks can be easily seen, and both luminance and chrominance components are distorted.

### **Visual comparison conclusions**

Visual comparison of WMPPhoto with JPEG 2000 codecs verifies PSNR results: its' quality is quite average, and there are no signs of "revolution" in compression ratio.

In our opinion, ACDSee codec has the best visual quality on this test set. It has the best PSNR values as well.

## Informal codecs comparison

As one can see on Y-PSNR diagrams codecs behave differently on different images and compression factors, so to understand the situation on the whole test set we suggested an informal estimation where every codec is given some score depending on the results of its measurement.

### Informal comparison rules

- WMPHoto with I=1 and all JPEG 2000 codecs are compared.
- If some codec is stably better than all the others it is given a score of 4 regardless of other results.
- If some codec is worse than all the others in more than one point it is given a score of 1 regardless of other results.
- Otherwise if codec is better than the reference one in more than one point it is given a score of 3.
- Otherwise it is given a score of 2.

### Informal comparison results

Codec	Barbara	Lenna	Lighthouse	House	Total	Place
ACDSee	4	4	4	4	16	1
Lurawave	4	3	3	4	14	2
Leadtools JPEG 2000 Photoshop plugin	3	3	3	4	13	3
Elecard Wavelet	3	2	3	3	11	4,5
JPEG 2000 Compressor (Anything 3D)	3	3	3	2	11	4,5
<b>WMPHoto</b>	<b>3</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>10</b>	<b>6,7</b>
Photoshop CS2 'native' plugin	3	3	2	2	10	6,7
Morgan JPEG 2000 toolbox	2	3	2	2	9	8
JASPER	2	2	2	2	8	9
Kdu_compress	1	3	1	1	6	10

## **General conclusions**

- Despite commercial announcements, WMPPhoto quality is similar to JPEG 2000.
- Some one-year old implementations of JPEG 2000 significantly outperform WMPPhoto in objective and subjective comparison.
- The battle of formats is still ahead: although JPEG 2000 may be better than WMPPhoto, its' support is still not added to many popular programs (browsers, viewers, image editors, etc.). Efforts in this field may lead to WMPPhoto domination despite worse compression possibilities.

## **Acknowledgements**

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## Appendix 1: JPEG 2000 codecs description

### Codecs

Codec	Manufacturer	Version
JASPER	Michael Adams	1.701.0
ACDSee	ACD Systems	7.0
Leadtools JPEG 2000 Photoshop plugin	Leadtools Technologies	1.0
Morgan JPEG 2000 toolbox	Morgan Multimedia	1.2 rev 0.0
Lurawave	LuraTech	2.1.10.04
Kdu_compress	Kakadu Software	4.5.2
JPEG 2000 Compressor (Anything 3D)	Anything 3D Corp	1.00.000
Elecard Wavelet	Elecard Inc.	3.0 Beta
Photoshop CS2 'native' plugin	Adobe Systems Inc.	1.6

### Codecs' settings

Codec	Parameter	Values
JASPER	rate	0.01, 0.024, 0.04, 0.06, 0.09, 0.107
ACDSee	compression ratio	100, 43, 25, 17, 12, 9
Leadtools JPEG 2000 Photoshop plugin	compress. ratio	100, 43, 25, 17, 12, 9
Morgan JPEG 2000 toolbox	quality	3, 7, 12, 18, 26, 31
Lurawave	quality	10, 30, 50, 70, 90, 100
Kdu_compress	bps	0.24, 0.56, 0.96, 1.44, 2.16, 2.56
JPEG 2000 Compressor (Anything 3D)	quality	5, 10, 20, 30, 40, 53
Elecard Wavelet	compress factor	1, 2, 4, 6, 9, 12
Photoshop CS2 'native' plugin	file size (kb)	7, 18, 31, 47, 68, 82

Other codecs' settings were left with their default values. You can see them on screenshots of codecs' interfaces. For more details on codecs used refer to [MSU JPEG 2000 Image Codecs Comparison](#).

## Appendix 2: Detailed images description

### Images properties

Image	Uncompressed file size	Resolution
Barbara	786486 bytes	512x512
Lenna	786486 bytes	512x512
Lighthouse	786486 bytes	512x512
House	786486 bytes	512x512

### Barbara



Barbara.bmp (50% size)

Name	Barbara
Resolution	512x512
Features	Black and white image. Main feature – stripes on table-cloth, on scarf and on pants where moire and other artifacts often appear.

## Lenna



Lenna.bmp (50% size)

Name	Lenna
Resolution	512x512
Features	Classical test image. Smooth color changes, borders.



## Lighthouse



Lighthouse.bmp (50% size)

Name	Lighthouse
Resolution	512x512
Features	Main features are sky, white fence, hand-rail on top of the lighthouse. By amount of their details it is possible to evaluate compression quality.

## House



House.bmp (50% size)

Name	House
Resolution	512x512
Features	Lots of high-frequency regions that are badly affected by compression (grass, leaves). Bright borders on the roof.

## About us (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.

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