# Psychovisual Comparison of Image Compressing Methods for Multifunctional Development under Laboratory Circumstances

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*Abstract:* In our days, interactive multimedia based client equipment (desktop), a palmtop or an equipment capable of mobile sound transmission (mobile phone, communicator) are all, though in different ways, suitable for interactive (multimedia based) knowledge transfer. The aim of developers is to pass the same knowledge no matter through what kind of medium. The practical realization of such multifunctional (on the equipment side) development raises several difficulties for the developers. The research was carried out under laboratory circumstances. Images compressed with the use of different compressing methods (Fractal, MrSID Wavelet, JPEG Wavelet) are compared to each other and to uncompressed TIFF images.

*Key-Words:* Psychovisual, Compressing, Multifunctional, Saturation, Shades, Recognition

## Introduction

In our days, interactive multimedia based CD-ROMs or DVDs, Internet network with multimedia based client equipment (desktop, laptop), a palmtop or an equipment capable of mobile sound transmission (mobile phone, communicator) are all, though in different ways, suitable for interactive (multimedia based) knowledge transfer. The aim of teaching material developers is to pass the same knowledge no matter through what kind of medium. The practical realization of such multifunctional (on the equipment side) development raises several difficulties for the developers. A leading role is given to the cost-effective network transmission of visual data. Cost-effective data transmission in our case – with still images - primarily means the transmission of high sign/noise rate visual data at the lowest possible size. The specific needs for this (eg. unique format, different colour depth, equipment dependent presentation size on the client side, or automatic/intelligent responses on the server side) are only partly solved by equipment producers, developers and/or mobile services. These solutions can rarely be considered cost-effective. The most effective still image compressing methods of present days have been compared under laboratory circumstances in order to find answers to the above questions.

## 1 Preliminary Examinations

The results of our previous research examinations (considering user points of view as well) have given us information on the comparison of two losing image compressing methods (JPEG and FIF) to each other and to uncompressed images. The research was carried out both under laboratory circumstances and through an Internet survey. These results have been published in publications [2], [3] (see Bibliography) and can be summarised briefly as follows:

- the laboratory examinations were carried out with the participation of 100 people, whereas the Internet survey was filled out by nearly 200 people. The Internet questionnaire

is still available and can be filled out at www.georgikon.hu/visual.htm.

- nearly 80% of the participants of the laboratory examinations studied advanced Information Technology. 40% of the total participants took part in multimedia based courses (multimedia equipments, multimedia software, computer graphics). 10 % of the participants in the research studied practical and theoretical digital image processing.
- according to the results of laboratory comparison of uncompressed and JPEG compressed images it can be stated that the users found the differences between JPEG 30:1 images and uncompressed images significant, that is disturbing.
- nearly everyone found the 'digital' (pixelization) effect when enlarging the images highly bothering.
- the users (in the laboratory experiment) found the difference between fractal compressed and uncompressed images noticable, some of them even disturbing. The 'digital' effect, which is so bothering for the human brain, was not felt by the users.
- comparing the two image compressing methods, significant difference could be found to the advantage of fractal compressed images. This could be felt mainly in colour shades.

Continuing our work, still as antecedents to the present study (connected to the national research program - development of multimedia based multifunctional information education and research material), the applyability of standards and descriptions to mobile, palmtop and desktop equipment were investigated. The development elements of multifunctional development were defined from practical developer and user viewpoints. Multifunctional materials were tested and developed, using the results of our research.

## 2 Research

Images compressed with the use of different image compressing methods (Fractal, MrSID Wavelet, JPEG Wavelet) are compared to each other and to uncompressed TIFF images.

Several modifications to the previously used examination methods were needed, the most important ones of them are:

- instead of comparing two images at a time, now four images are to be compared,
- instead of images on slides, images made by digital equipment (camera) are being used in the present research,
- the asked questions cover deeper information,
- the examinations are carried out with the help of an internal network.

Technical details:

The 3x10 bit, 2160x1440 pixel RAW images used in the experiment had been taken by Canon EOS D30 digital camera. The images are used in the experiment after pre-processing (converting and applying to the viewing equipment).

Photoshop 6.0.1 software is used for viewing. The images were loaded in automatically in standard tiling with the help of 24 bit TIFF, Iterated Inc. Fractal, MrSID Lizardtech GF Print Pro 2.5, JPG2000 Algo Vision LuraTech 7.4.262.0 plug-ins.

The participants of the test, independently of previous professional qualifications, are given the same (verbal and written) information on sizing possibilities and the questions. They are given ideas on which parts of the images are worth examining to answer the questions on enlarging.

The test is carried out in a classroom with 20 (present day technical level) computers.

There is possibility to darken the room adequately.

Hardware: IBM PC, 1.6 GHz INTEL processor, 256 MB memory, NVIDIA Vanta 16MB video card, IBM 6632-67 N/C 17" monitor
Software: Windows XP Professional, Adobe Photoshop 6.0.1 CE English version
Settings: Screen: 1152x864 pixel, 32bit colour depth, 75 Hz refresh frequency
Duration: appr. 60 minutes (6 minutes/question, 20 minutes/question groups)
The test is being filled in continuously. Until 16.03.2004, 165 students had filled it in. The variety of answering students is getting wider and wider (in terms of age group, knowledge of IT, sex). In this paper, the results of these 165 filled-in tests are analysed.

The Questions:

1. What is the difference of colour shades compared to the etalon image (image 1)?
   (none) (hardly any)
   (minimal) (significant) (big)
2. How much have the colour shades of the images changed after 4x enlargement (image 1)?
3. How much is the difference in continuous colour shades compared to the etalon image (image 1)?
4. How much is the difference in the visibility of small details compared to the etalon image (image 3)?
5. How much is the distortion of geometric figures compared to the etalon image (image 3)?
6. Put the images into order according to the visibility of small details after 8x enlargement. Start with the best image. (image 3)
7. Put the images into order according to the visibility of small details after 16x enlargement. Start with the best image. (image 3)
8. Put the images into order according to recognition of figures. Start with the best image. (image 3)
9. How much is the change in colour saturation compared to the etalon image (image 2)?
10. How much has colour saturation changed after 8x enlargement compared to the etalon image (image 2)?

The images are available at www.georgikon.hu/digkep/visual2/index.htm (JPEG format).

## 3 Results

The 165 filled tests have been grouped according to several viewpoints:

- Men/women
  A significant difference has been found only in questions 6-7-8. Women found uncompressed (TIFF) images the best at a significantly higher rate (10%).
- The tests in which uncompressed (TIFF) images were found the best in questions 6-7-8 have been analysed further. There were 46 of them, which is 31.15%. This figure shows two important aspects. First, it indicates that 40 times compression of images can be done with very little loss in quality. Second, every third partaker of the experiment was able to select the uncompressed images. Had answers been given at random, this figure would have been 1.5% ($100/4^3$), supposing four possibilities and three answers). These 46 tests have been used to control and empower the results of the whole research later.

Difference in shades
There are two questions concerning difference in shades to the etalon image. With both enlarged and normal size images, fractal compressed images seem to be unanimously the best.

Order of quality:

1. Fractal
2. MrSID
3. JP2000

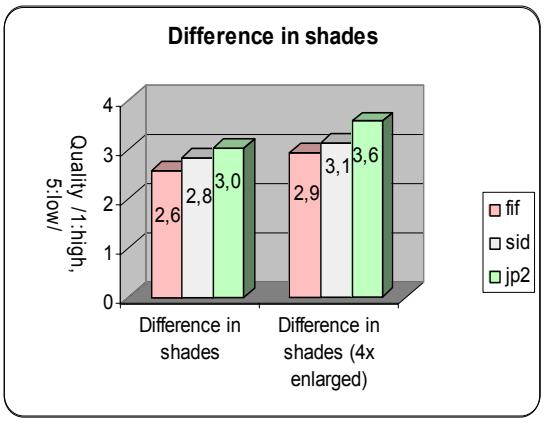


**Figure 1.**
Difference in shades

Difference from continuous colour shades

The analysis of results on difference from continuous colour shades have shown no significant differences. A reason for this might be that there are really slight differences between compressing methods in this respect. This result is supported by the answers given to the above mentioned 46 control tests, in which the differences are even lower.

Difference in saturation

Differences from the etalon image in saturation were examined in two questions. Both with and without enlargement, MrSID format have proven to be the best.

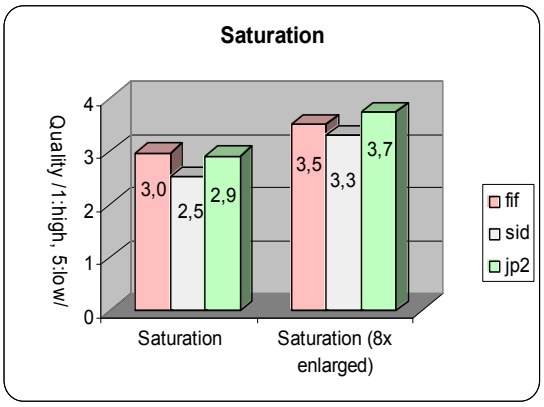


**Figure 2.**
Difference in saturation

Order of quality:

1. MrSID
2. Fractal
3. JP2000

Difference in visibility of figures and details

There has been no significant difference in the visibility of figures and details in the case of 4 times enlargement and normal size images. In the case of 16 times enlargement, however, JP2000 compression method seems to give the best quality.

Order of quality (16x enlarged):

1. JP2000
2. MrSID
3. Fractal

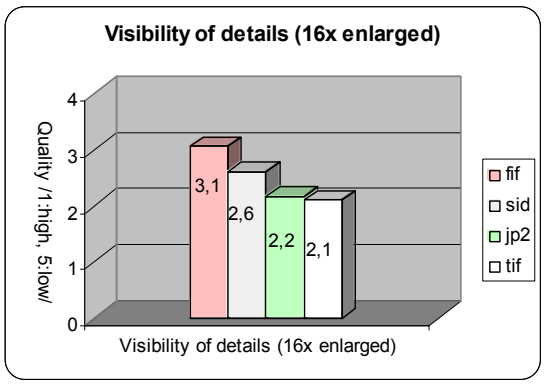


**Figure 3.**
Difference in visibility of details (16x enlarged)

Difference in distortion and recognition of figures

The same results have been achieved examining distortion and recognition of figures.

Order of quality:

1. JP2000
2. MrSID
3. Fractal

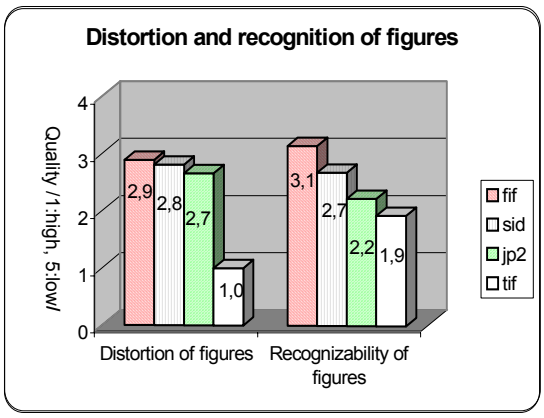


**Figure 4.**
Difference in distortion and recognition of figures

## 4 Conclusions

40 times compression from 9MB to 220 KB gives very good quality with all the three image compressing methods. In the case of 4 times enlargement of compressed images, no significant difference has been found in continous colour shades or the visibility of small details.

All the three examined methods have their strong and weak points. Fractal compression can be very well used to give back colour shades (fig. 1.) but not figures or details (fig. 3., 4.). MrSID image compression method is to be used when saturation (fig. 2) is important and works with an average quality in colour shades (fig. 1.), details and recognition of figures (fig. 3., 4.). JP2000 method seems to be the best in terms of recognition of figures and details (fig. 3., 4.), but it is less efficient with shades and saturation (fig. 1., 2).

No significant difference has been found when comparing men and women apart from the fact that 10 % more women found uncompressed (TIFF) images the best. Due to the low number of participants, other differences are within normal margins of error. Answer to this aspect can be given after a higher number of people have filled in the test.

The effectiveness of JP2000 with recognition of figures and details makes it suitable for compressing detail-rich images like maps. GeoJP2 compressing method developed by Mapping Science makes it possible to produce georeferenced compressed images in JP2000 format. Lizardtech Company has bought Mapping Science with GeoJP2. If the Lizardtech company will be using GeoJP2 format, the comparison of GeoTIFF, MrSID and GeoJP2 formats will be an important aspect. Another question is to what extent MrSID format is to be developed.

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