VISUALIZATION TOOLS USING *FLASHPIX* IMAGE FORMAT

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ABSTRACT

Photogrammetric data, whether it refers to terrain or to close-range images, are typically massive in size. This results in a dataset that is often too large to handle and prohibits any form of real-time interaction or even visualization. Therefore, special database structures and image storing formats should be sought.

FlashPix image format supports images of any size, and any resolution. Images in *FPX* format are stored at multiple independent resolutions. This special structure allows applications to select the appropriate resolution for a certain procedure and to access directly the specific areas of an image needed for the operation being performed. This eliminates the need to process the entire image for viewing a small part of it, or to handle a large amount of data (high resolution image) in order to produce a smaller amount of data (displaying a lower resolution image).

This paper presents research efforts on identifying visualization tools, which can make use of this special image format, taking thus advantage of its special data structure.

1. INTRODUCTION

Images are stored in different formats and different resolutions depending on the application and requirements of the user. Images format can be classified as follows:

- Platform dependent formats: many graphical/imaging applications create their own file format particular to the systems they are executed upon. For example: Microsoft Windows - BMP format, Macintosh – PAINT and PICT used by MacPaint and MacDraw programs, etc.
- Platform independent formats: There are the most popular ones, which run on almost all platforms. For example: TIFF, JPG, GIF, PNG format, etc. Each of them has its limitations and its strengths respectively.

The increasingly large–capacity hard drives on today's PCs can accommodate images that takes 5Mb, 10Mb, …, 20Mb fairly well. But what it happens when someone wants just to "open" an image of 100Mb or more? And even worse what it happens when he wants to transmit these huge data sets across the Internet? To reduce the information to be handled, compressed formats like GIF and JPG are used instead of the original bitmapped image format such as TIFF. GIF and JPG compressors are very effective, but they come with a loss of quality, especially in the GIF format. GIF also has the limitation of supporting only 256-color depth.

A way, to overcome the majority of the above mentioned problems, seems to be the use, of an almost new format, like *FlashPix (FPX)* format. *FlashPix* is a graphics file format developed by Microsoft, Live Picture, Hewlett-Packard and Eastman Kodak. It is a multiresolution format, and for this reason a resolution - independent format, that can handle efficiently any kind of images at any resolution, offering at the same time major advantages, among them networking as well.

It was developed about 6 years ago, and what makes it the most hopeful universal format of the future, is the recent development in applications and system software that support the format. "Support", implies a number of capabilities, including the ability to create originally *FPX* images, to convert images from other formats into *FPX* format, to view and to handle *FPX* images in and out of the web, etc.

Some of the Software Houses already include the *FlashPix* format in their products, like: Adobe, Corel (Photo Paint), Microsoft (PictureIt, Explorer), ACDSystems (ACDSee), etc. The *FlashPix* format has been already used for transfering image data through Internet, with interesting and encouraging results.

2. FEATURES OF THE *FLASHPIX* FORMAT

Multiple independent resolutions and tiling

It contains a hierarchy of several lower-resolution images (Pyramid) within the same image file. The overall size of a *FlashPix* file is approximately 33% larger than a comparable flat file, as the entire resolution pyramid is stored in the archive rather than being computed on-the-fly. Applications can quickly access a low-resolution image for on-screen display or on-line use, or employ the highest-resolution image for higher-quality output. Within a resolution, data is organized into tiles of 64x64 pixels. Incomplete tiles should be padded with the values of the rightmost pixel in each row. Tiling allows *FPX* applications to work fast, with less I/O and processing demand. *FPX* tiles can be uncompressed, JPG compressed or single color compressed, depending on the application.

Structured storage
Employs Microsoft's OLE structured storage format, which holds image data and related descriptive information in a standardized "Wrapper". Allows developers to add proprietary features without converting the image to a new format.

Linking
Images can be used in multiple ways but the original high resolution image data can be stored in only one place

Viewing parameters and result images
Records edits to an image as small scripts called "viewing parameters" –applied to high-resolution images only when necessary- for "just-in-time" rendering.

Built-in color spaces
Supports both a calibrated RGB color space and a calibrated Photo YCC color space.

Descriptive information
Aids in developing image databases and describing the image source to applications and devices that will use the file.

A detailed description-documentation of the features of this format is done in Donovan K. 1998, Eastman Kodak Company 1996, 1997, Georgoula and Patias, 2002, etc.

3. THE EXPERIMENT

The visualizations tools that handle *FPX* format, in and out the web, are many: e.g. Photoshop (Adobe), PhotoPaint (Corel), ACDsee (ACDSystems) [URL1], PictureIt (Microsoft) [URL2], Isee imaging software (Isee Imaging Systems) [URL3], OpenPix (HP), IrfranView (Web Technologies) [URL4], etc.

The aim of this project was to test some of these visualization tools. The examinations concerned to:

- Testing the capabilities of each software to handle efficiently an *FPX* image format, taking the advantages of its special structrure,
- Revealing the advantages of this format against a TIF or JPG format.

The tests concerned PhotoPaint 10, ACDsee 5.0 and Explorer. In the latest the image viewer for the *FPX* format was the Isee Media zoom viewer.

3.1. The data sets

For our tests an original image test.tif has been used. It was an orthophoto, in BW, 15360x15360pixels. The original image has been converted in uncompressed FPX, using Corel PhotoPaint10. The names of the images and the amount of data (in MB) for each one different image format, are shown in the Table 1.

TIF **test.tif**	**FPX** Uncompressed **test.fpx**
225MB	305MB

Table 1:
The image data sets that has been used in the experiment

The image test.fpx, that is an uncompressed *FPX* image, is as big as 305Mb, that is about 33% more than the original test.tif image. The file test.fpx has the image data organization of a pyramid, as follows (Table 2):

Level	**Dimensions (pixels)**	**Approximate volume (MB)**
8	15360x15360	235.92
7	7680x7680	58.98
6	3840x3840	14.74
5	1920x1920	3.68
4	960x960	0.92
3	480x480	0.23
2	240x240	0.05
1	120x120	0.01
0	64x64	0.0
TOTAL		**314.48**

Table 2: Pyramid levels of test.fpx file (uncompressed)

3.2 Abilities and Performance of the tested tools

Many software packages claim that they can use *FPX* format. The presented software tools are the ones found, up to now, to be using the *FPX* structure to a more or less degree. From those, Photopaint 10 and ACDsee 5.0 exhibit the most complete use of the *FPX* characteristics. ACDsee is only an *FPX* viewer without having the ability to create *FPX* files. The last one, Isee, is the simplest viewer, but with direct Internet capabilities. The following table (Table 3) presents in summary the basic characteristics of each tool.

Tested tool	Create view *FPX* files	Multi layer pyramid	Viewing parameters	Metadata
PhotoPaint	create/view	yes	yes	yes
ACDsee	view	yes	yes	yes
ISee	view	yes	no	no

Table 3: Exploitation of the FPX characteristics

Photopaint has both the ability to create (convert to) and view an *FPX* file. In creating/converting mode, the user is been given the choice to also use compression

schemes, like: single color compression, blind JPG compression, JPG compression selected by desired quality. Additionally, metadata information can be stored in the "scene contents" and summary" fields. In viewing mode, the user can select to modify the viewing radiometry (brightness, contrast, color LUT etc.) without modifying the actual original image. These new viewing parameters are then stored, in a script, for later use (or anytime the image is viewed).

Photopaint software makes use of the multiresolution feature of the *FPX* image in two cases, that is: for the preview image and for loading an image of lower resolution than the original, if the option is "resample". Thus, during the action of selection of images to be loaded, the time of appearance of the preview images of the test.fpx files was about 2sec, while the equivalent time for the test.tif was 10sec. In the case that the option of loading an image is "resample", the user may determine the desired resolution (or pyramid level). Choosing a resolution of 1920x1920pixels the image test.tif was loaded in 80sec while the test.fpx in 33sec.
The big advantage of the pyramide structure is obvious when retrieving the image. As it shown from the previous experiment (see also Table 4) the upper levels of the pyramid are viewed with quite large time savings (almost up to 70%). The deeper one goes into the pyramid, the less the time savings, which of courses are zeroed out at the bottom level of the pyramid. This conclusion is valid for all types of contents and volumes of the images and, as expected the time savings are more profound to large images, as is the case with photogrammetric images.

tool	level	test.tif	test.fpx
PhotoPaint	Full image	78sec	250sec
	5	80sec	33sec
	2	78sec	12sec
ACDSee	Full image	80sec	220sec
	5	-	0.5sec
	2	-	instant
Explorer	2	300sec	17sec

Table 4: Image retrieving/viewing times

ACDSee software has the ability to view an *FPX* image, but not to create one**,** however it takes advantage of the special structure of *.fpx images. The software makes use of the multiresolution feature of the *FPX* image in two cases, that is: for the preview image and for loading an image of lower resolution than the original. Thus, during the action of selection of images to be loaded, the appearance of the preview images of the test.fpx files was instant, while the time for the appearance of the preview image of test.tif and was 39sec. ACDSee gives the option to load an *.fpx file determining the desired resolution-layer. The layer 5th (1920x1920pixels) of the file test.fpx is loaded in 0.5sec. The full test.fpx image was loaded in 220sec, while the equivalent time for loading the test.tif was 80sec. (Table 4).

In **Explorer** for test.fpx image the **Isee Media Zoom** Plug-in viewer for Windows has been used. It is just a simple viewer developed especially for *FPX* images.
The image test.fpx, has been loaded in 17sec. The zoom in and zoom out of the image works very fast and the loading of the different layers is obvious. On the contrary, the file test.tif takes about 300sec.

4. THE FPX FORMAT ON THE WEB

While the performance of desktop systems, workgroup LANs, and Web servers have increased rapidly, Web imaging applications have been limited by the performance of the Internet, where bandwidth is growing slowly. Web designers are faced with a difficult compromise between image quality and download time. The Internet Imaging Protocol (IIP) addresses the challenge of providing pervasive access to high quality images over the Internet especially for publishing and printing applications. IIP uses network bandwidth efficiently, making it possible to design Web pages that are image-rich and responsive, while preserving access to high quality, high-resolution data for zooming in on fine image details or background output to a printer. IIP makes it possible to use large, photo-quality images without waiting for a multi-megabyte image to download. It can deliver interactive performance even in a low-bandwidth, low-memory client environment.
The Internet Imaging Protocol is structured to take advantage of the *FlashPix* image architecture, but it also provides a uniform method for presenting an image from any format to a client in a resolution-independent, bandwidth-efficient manner. Using IIP, applications can quickly browse an image using a few tiles of data, while retaining access to the full high-resolution image on the server. IIP allows a single image file to be used for fast browsing, high-resolution printing, complex image manipulation, and simple snapshot viewing. The IIP functions can access all the image information in the underlying file, like image technical features and author information, without requiring extensive server-side processing [URL5], [URL6], [URL7]. Our initial tests have shown that download speeds are similar to those experienced and reported at 3.2.

5. CONCLUSIONS

This paper aims at checking the efficiency of the *FlashPix* image format, testing the respective ability of popular image creation, conversion and viewing software. One of the major conclusions is that although many software claim ability to view FPX files, in most cases they actually do not fully exploit the pyramid

structure and thus they do not exhibit the expected special advantages. The three tested tools (PhotoPaint, ACDsee, Isee) that actually take into account the special *FPX* structure have shown remarkable advantages in viewing speeds. These advantages are more profound in large image files and in viewing of upper pyramid levels. Retrieving time saving up to 70% are reported. Retrieving speed is even more useful in Internet applications. Similarly, downloading time savings of similar range have been experienced here also, during our initial tests, regarding IIP. It should be noted that in all cases there was no degradation of see image quality. Moreover the viewing of the upper pyramid levels in *FPX* files exhibits rather better quality, since it is not affected by aliasing effects.

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