Overview

In the last ten years new image technologies have been developed to overcome some disadvantages of older still image formats like JPEG. The two biggest disadvantages of JPEG are the missing lossless compression mode and the missing progression in quality or resolution. Of course, both of these disavantages have been fixed with separate, incompatible file formats. Obviously, the time was ripe for new, single file formats, comprising all good features of several JPEG types.

Almost at the same time, two new still image file formats have been announced: PGF and JPEG 2000. PGF has been developed by xeraina, a Swiss Federal Institute of Technology spin-off company, while JPEG 2000 is a new standard of the Joint Photographic Experts Group committee. Both, PGF and JPEG 2000 are incompatible with JPEG. Unfortunately, JPEG 2000 is several times slower than JPEG and therefore not a good candidate to replace JPEG in some areas, but PGF is a real candidate!

PGF vs. JPEG (2000)

PGF is an abbreviation for Progressive Graphics File. PGF and JPEG 2000 are based on similar technologies. but PGF is almost as fast as the original JPEG with some advantages compared to JPEG: PGF achieves in general a better quality (PSNR) than JPEG at the same compression ratio (Figure 3) and it allows loading and displaying images progressively without any loss in encoding/decoding speed (Figure 1). The latter feature is a real advantage for transmitting large images through a channel with limited bandwidth like the Internet, since the receiver gets very soon an early version of the transmitted image. It also allows the user to inspect more images in the same time. PGf is best suitable for natural and aerial images.
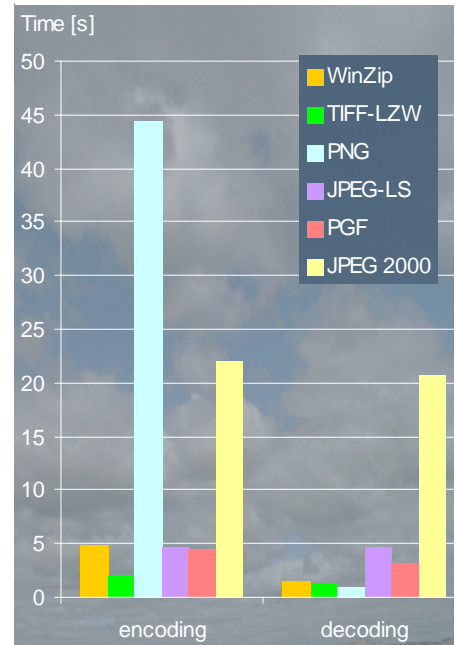
info@xeraina.ch
http://www.xeraina.ch/pgf

Figure 1 The encoding and decoding times in seconds. PGF has the second fastest encoder. The times are averages over nine Sinar test images, computed on a 2.4 GHz Pentium 4 processor on a Windows XP platform. The sizes of the images vary between 5 and 64 MBytes.

Facts

- lossless and lossy image compression modes
- lossless compression ratio of about 3.1 (Figure 2)
- lossy compression ratio of more than 10 without any visual quality loss (Figure 3)
- progressively increasing image resolution and/or quality
- better image quality at the same compression ratio than JPEG (Figure 3)
- as fast as JPEG in encoding and decoding (Figure 1)
- 31 bit per pixel and per channel
- separate transparency channel

Codec and Applications

The PGF codec is written in portable C++ code. It runs on most standard platforms without any problems and it has been tested on Windows, Macintosh, and Linux platforms.

Based on PGF codec several applications have been implemented:

- *PGF Image Viewer* is an application similiar to Microsoft's PhotoEditor. It is only available on Windows platforms. Besides PGF type images it handles BMP, GIF, JPEG, PNG, and TIFF image types;
- *PGF Image Control* is a Windows ActiveX component for progressive loading and visualizing PGF images

in any ActiveX container like Internet Explorer IE, Microsoft Word, or any other Microsoft Office application;

- *PGF for Photoshop* is plug-in for Adobe's Photoshop version 6.0 and newer and any other Adobe applications which are able to handle Photoshop plug-ins. It is available for Windows and Macintosh platforms;
- The *test and measurement tool* helps you to evaluate the performance (compression ratio, encoding and decoding speed) of the PGF codec on any Windows platform. Have a look at http://www.xeraina.ch/pgf/pgf-download.html.
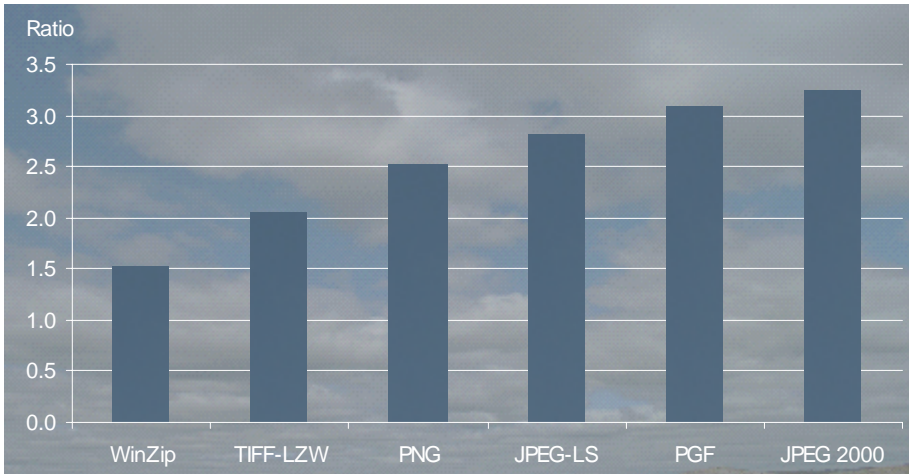
Figure 2 The compression ratios of six different lossless compression methods. PGF is the second best. The compression ratios are averages over nine Sinar test images, computed on a 2.4 GHz Pentium 4 processor on a Windows XP platform.
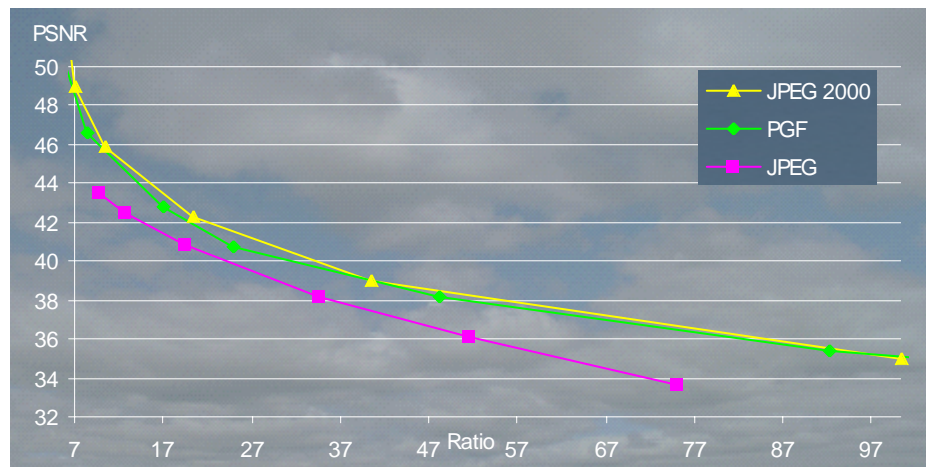
Region of Interest (ROI)

The newest version of the PGF codec supports a simple but very efficient ROI concept. PGF images supporting ROI are slightly different encoded. The new encoding technique results only in small changes in compression ratio (± 0.1), but allows decoding of rectangular regions without decompressing the entire image. This saves a lot of time if you are only interested in a small part of a large image.

Hardware Implementation

The PGF codec is best suitable for a hardware implementation, because it is completely integer based and does not use fix point operations. The internal word length is 32 bit.

Progressive Enhancement

The core technology of PGF is a wavelet based image transform combined with a very fast but quite simple compression technique. Some parts of the used technology are very similar to JPEG 2000, but other parts are simpler and therefore, much faster.

Due to the hierarchical structure of wavelet transforms PGF is best suited for progressive enhancing image resolution and quality during loading and visualization. Because the current JPEG standard does not allow progressive resolution or quality enhancement, there is a huge need of additional thumbnail images both on Internet web pages and in digital cameras with preview displays. Using PGF instead of JPEG renders thumbnail images unnecessary. Just reading a small prefix of the PGF image file is enough to quickly visualize a small preview.

Image Modes

PGF is able to handle up to 8 different information channels. An information channel is for example simply a color channel or a transparency channel. Each channel has a word length of 31 bit. So, the 12 bit colour depth of common CCD chips can be fully supported. For example, the *PGF Image Viewer* visualizes the following image modes:

- Bitmap (1 bit)
- Grayscale (8, 16, and 31 bit)
- RGB (12, 16, 24, and 48 bit)
- RGBA
- CMYK (32 and 64 bit)
- CIE L*a*b* (24 and 48 bit)
- Index color (8 bit)

PGF for External Storage

PGF for external storage (PGFExt) is an extension of the PGF technology. It is able to handle very huge images (several hundred megabytes and more) on external disk storage. Such large images do not fit in main memory as a whole and therefore, special tiling techniques are necessary to allow visualization and editing of image parts. PGF as base technology is best suitable because of its efficiency and large decoding speed.

Patents

The whole PGF technology has been built without any patented algorithm and technique and has been published by Dr. C. Stamm, one of the founders of xeraina, and therefore, is protected by copyright.

Figure 3 The quality (Peak Signal Noise Ratio, PSNR measured in dB) depends on compression ratio. The quality of PGF is similar to JPEG 2000, but clearly better than JPEG. The PSNR values are averages over nine Sinar test images, computed on a 2.4 GHz Pentium 4 processor on a Windows XP platform.