

Tips to make reports with Enif graphics



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1

This is a revised version of the paper originally presented at the 12th European EMME/2 Users' Conference in Basel, Switzerland on 22-23 May 2003.

Enif is software used to access EMME/2 data banks with a modern interface. This presentation includes tips on generating output from Enif and discusses alternative graphic formats for the preparation and distribution of reports.

The graphics included in this presentation are to be displayed directly from OpenOffice Impress or to be printed in color directly from OpenOffice Impress for distribution. Conversion of this presentation into PDF form from OpenOffice 1.0.2 introduces distortion: the quality of the graphics is equivalent to JPEG at 50% compression. Conversion of this presentation into web format necessitates that the graphics be saved in JPEG or GIF format, which also introduces distortion.

Graphics were generated in various graphic file formats using an Intel PC with Windows XP and the most recent official release of Enif, version 1.0. This presentation itself serves as an example of how Enif images in various formats can be incorporated into a presentation.

Online references:

- Graphic file formats at a glance acomp.stanford.edu/acpubs/Docs/graphic_file_formats/
- PostScript vs. PDF www.adobe.com/print/features/psvspdf/main.html
- The Official Free PDF Support Site www28.brinkster.com/freepdfsupport/index.html
- How to Create Adobe PDF Files for Print and Press
 www.adobe.com/products/postscript/pdfs/pdfforprint.pdf

Contents of presentation

- Types of reports
- Raster graphics
- Vector graphics
- Graphics format recommendations
- Tips for Enif output

These notes (i.e. below the presentation slides) serve the purposes of

- documenting the oral content to the presentation,
- providing additional technical content, and
- supplying details so that the audience may replicate the graphics presented.

This presentation does not comprehensively define graphic file formats. The definition and description of the various graphic formats is limited to those aspects which are relevant to producing reports with Enif graphics.

Demonstrations are included to cover the following activities

- generation of graphics of Enif plots,
- manipulating those graphics,
- inserting the graphics into report-creation software, and
- saving the reports for distribution.

The appendix details various software installations and the procedures used to generate the graphics discussed in this presentation.

Types of reports

- How will the audience be reached?
 - Print the report
 - Post an HTML report
 - Distribute the report in electronic PDF format
 - Present the report live
- Understand the limitations of the software, hardware, and materials used to generate reports.

Understand the limitations of the software, hardware, and materials used to generate reports.
How will the reader access the report?

Printed report

- Identify the image-handling capabilities of the software used to create the report.
- Test that the colors are distinguishable if printed in black & white.
- Choose the paper size, e.g. A4, letter, or large format.
- Choose a paper type that works with your printer and its ink.

Browse an HTML report

- Which browser? Different browsers support only certain image formats and may render HTML or process scripts with differences that effect the appearance and functionality of your page. Poll your audience to determine which browsers are used.
- Design the layout to fit the resolution of the monitor.
- Should the report be printable? Browsers do not print HTML consistently. See electronic distribution below.

Electronic distribution in PDF* format

* PDF files are viewable with Adobe Acrobat Reader, available at no charge. Other formats that require the purchase of software to view the file are discouraged.

- Consider the same issues as a printed report, plus...
- Generate the report in PDF format. (FreePDF-generation software is discussed later.)

Presentations

- Identify the image-handling capabilities of the software used to create/present.
- If presented with printed slides, choose a slide compatible with your printer and ink.
- If presented with a projector, note the limitations of projector resolutions

Raster images

- A raster graphic is a graphic drawn as an array of colored dots.
- Advantages
 - fast screen rendering
 - compact for photos
- Disadvantages
 - not scalable
 - loss due to compression depending on format
 - potentially very large files

Raster image formats

<u>Format name</u>	<u>.ext</u>	<u>Color</u>	<u>Compression</u>	<u>Transparency</u>
bitmap	BMP	max 24-bit RGB		
joint photographic experts group	JPEG	24-bit RGB	lossy*	
portable network graphics	PNG	max 48-bit*	lossless*	yes
portable bitmap	PBM	1-bit monochrome		
portable graymap	PGM	8-bit grayscale		
portable pixmap	PPM	24-bit RGB		
X bitmap	XBM	1-bit monochrome		
X pixmap	XPM	24-bit RGB	lossless	
graphic interchange format	GIF*	max 8-bit	lossless	yes
tagged image file format	TIFF*	24-bit RGB	lossy & lossless	yes

*proprietary formats not supported by Enif

*file size is affected by Enif's Quality setting

*Enif output is 24-bit RGB

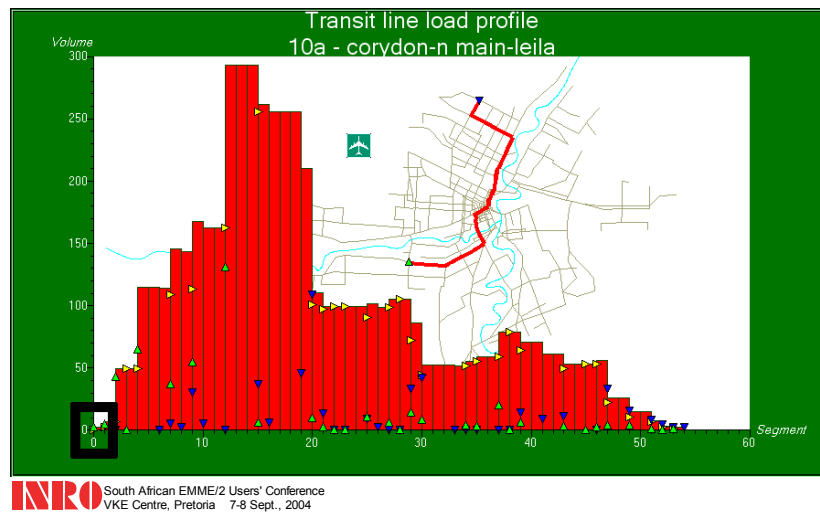
Eight bits is adequate for 256 colors or 256 shades of gray. RGB color capability requires 24-bits: 256 shades each of red, green and blue to yield 16.7 million colors. If a limited color palette is used, then 8 bits is adequate and 24-bits is wasted memory.

Lossy compression reduces the file size at the expense of image quality. JPEG lossy compression (optionally supported in TIFF) distorts sharply contrasting boundaries.

Lossless compression reduces the file size at the expense of rendering speed. The image quality is not affected. Lossless compression is efficient for images with areas of homogeneous color, such as drawings.

Transparency is useful for annotations in Enif. For example, highway number symbols are not square shaped.

Sample plot

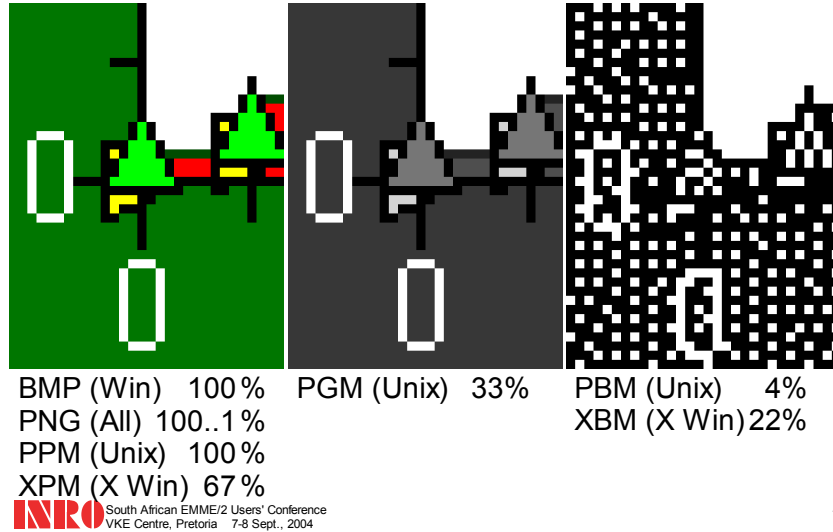


This sample image was used to demonstrate the qualitative and quantitative comparison of various image formats. The small black rectangle was enlarged to make the differences visible.

This image is the Enif plot configuration, found in the *Plots* menu under *Winnipeg plot configurations > Transit network and results > Transit line load profile* with the following settings

- predefined view: *Whole network*
- removed wallpaper background
- generated a file for each graphic format with commands *Export print view to image file* or *Print current view* from the *File* menu

Image formats with lossless/no compression



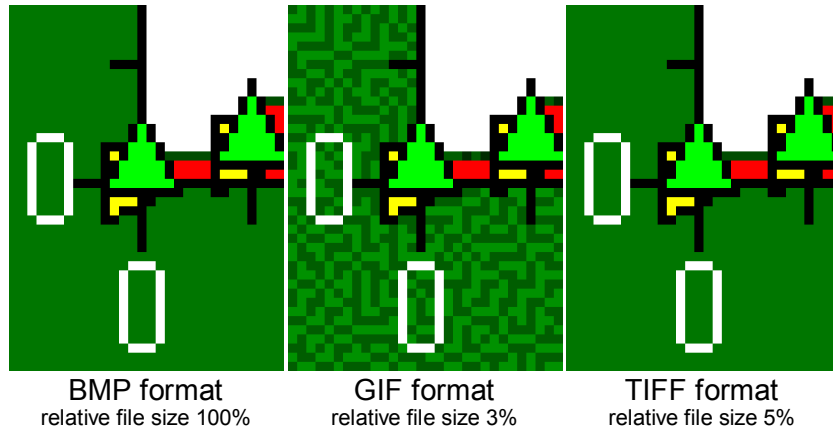
7

The numbers are the relative file sizes, where the whole image has size 100 = 1 978 818 bytes \approx 2Mb.

The PNG image format has lossless compression, which reduces the file size at the expense of rendering speed. The file size of this image was reduced by 99%.

PNG is the preferred format for raster images as long as the software being used to display the report with Enif plot images supports the PNG format. For example, Internet Explorer 4 and Netscape 4 do not support PNG at all. IE 6 renders PNG images, but does not handle PNG transparency.

Converted raster graphics

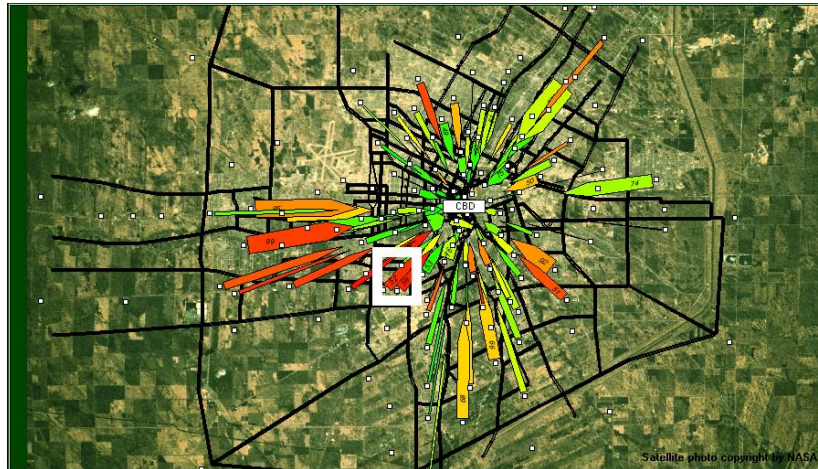


Enif does not support the GIF or TIFF formats. The BMP file was resaved as a GIF file and a TIFF file.

The GIF format supports only 8-bit = 256 colors. Note the approximated green color. If the Enif plot uses only the standard web colors, then converting the image to GIF will yield no loss of quality.

TIFF supports lossless compression. Note that there is no distortion in the converted TIFF image. Support of the TIFF format by various software is better than for PNG now, so converting Enif PNG images to TIFF is a good alternative.

Sample plot with a background image



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VKE Centre, Pretoria 7-8 Sept., 2004

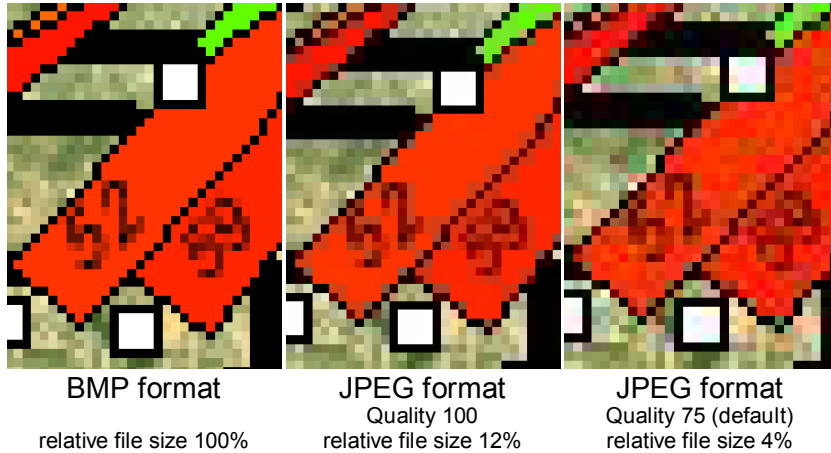
9

The satellite photo is a JPEG image used as a background image in this Enif plot configuration.

This image is the Enif plot configuration, found in the *Plots* menu under
Winnipeg plot configurations > Demand > Desire lines between zones
with the following settings

- *Full view*
- files generated with *File* menu items *Export print view to image file* or *Print full view*

JPEG lossy compression



The BMP format serves as a consistent benchmark because it does not support compression.

The JPEG lossy compression was designed for images with continuously varying gradation, such as photos. The distortion of photographic images is acceptable when weighed against the savings in file size. Note the distorted background image. The distortion of text and shapes with high contrast makes JPEG a poor choice as an export format for most Enif plots.

Demonstration: Enif raster graphics

- export an image in Enif
 - adjust the Enif window size
 - select “Export...” from the File menu
 - specify the graphic format with a file name extension
 - set the Enlargement
 - set the Quality (affects only JPG and PNG)
- add the image to a web page
- do not resize the image

To save an image (raster format) in Enif:

- Fix the proportions of the view port by adjusting the size of the Enif window. Check the dimensions of the view port with the tool tip of the pan panel.
- Select *Export screen view to image file* or *Export print view to image file* from the *File* menu.
- Set the *Enlargement* factor (up to 8) to increase the image resolution. The processor time and the file size increase with the square of this factor, so do not use bigger enlargement factors to be on the sure side!
- Set the *Quality* from 0 for maximum compression to 100 for no compression. The *Quality* setting affects only the JPEG and PNG formats. The quality and the file size decrease for a JPEG file, where the default *Quality* is 75. Only the file size decreases for a PNG file; the quality remains the same. The default *Quality* has a value of 30 for a PNG file.
- Enter the file name with the correct extension.

Post-processing a raster graphic:

- Avoid post-processing the image to obtain the best quality raster graphics: adjust the Enif window and set the *Enlargement* factor appropriately before exporting the image from Enif.
- Resizing a raster graphic will distort the image. Resizing is accomplished by resampling (throwing away pixels) or interpolation (estimating the color of added pixels). Resizing can be done with Microsoft Paint or by specifying attributes of the HTML tag, such as *width* and *height*.
- Rescale/resample a graphic to increase the resolution for printing. Rescaling can be done with Jasc Paint Shop Pro, Adobe Photoshop, and other image manipulation software, but not Microsoft Paint.
- A raster graphic can be easily cropped with any image manipulation software.

Vector graphics

- A vector graphic is a graphic drawn as lines, polygons and text.
- Advantages
 - scalable
 - compact for images composed of geometric shapes
- Disadvantages
 - generating vector graphics requires additional software with careful configuration (on Windows)
 - displaying vector graphics requires specific software and can be computationally expensive

Vector graphics formats

- **PostScript**
 - a page description language designed to describe accurately the appearance of a page
 - a proprietary format owned by Adobe
 - commonly stored in PS, EPS, and PDF files
 - a Raster Image Processor (RIP) interprets textual PostScript code as dots
- **examples of other vector formats**
 - CGM: computer graphics metafile
 - WMF: Windows metafile
 - DXF: AutoCAD

All PostScript-compatible printers have a Raster Image Processor (RIP). Displaying a *.ps* file on the screen requires a viewer with a RIP, such as Ghostscript with GSView, and can be computationally expensive. Only high-end (expensive) publishing software have a built-in RIP to view and manipulate *.ps* graphics. It is more convenient to work with a raster preview of the graphic, which is embedded in the EPS format. EPS also simplifies the display of a vector graphic with a bounding box.

Some programs that can import EPS graphics:

- Microsoft Word 2000+ *
- Microsoft PowerPoint 2000+ *
- OpenOffice 1.0+
- Quark Express
- Adobe Photoshop, Illustrator, InDesign...

* MS Office 1997 claims to import EPS files, but I had limited success with EPS files in Word '97 and Powerpoint '97.

PS and EPS file formats

- PS was designed for consistent, accurate printing of an entire file.
- Encapsulated PostScript files can be inserted into report-generating software
 - may contain an encapsulated raster preview image
 - a bounding box identifies the relevant portion of the page
- Printing PS and EPS requires a PostScript printer.

Excerpt of a PS file:

```
%!PS-Adobe-3.0
%%Title: MS Shell Dlg
%%Creator: PScript5.dll Version 5.2
...
```

Excerpt of an EPS file:

```
%!PS-Adobe-3.0 EPSF-3.0
%%Title: MS Shell Dlg
%%Creator: PScript5.dll Version 5.2
...
```

PDF file format

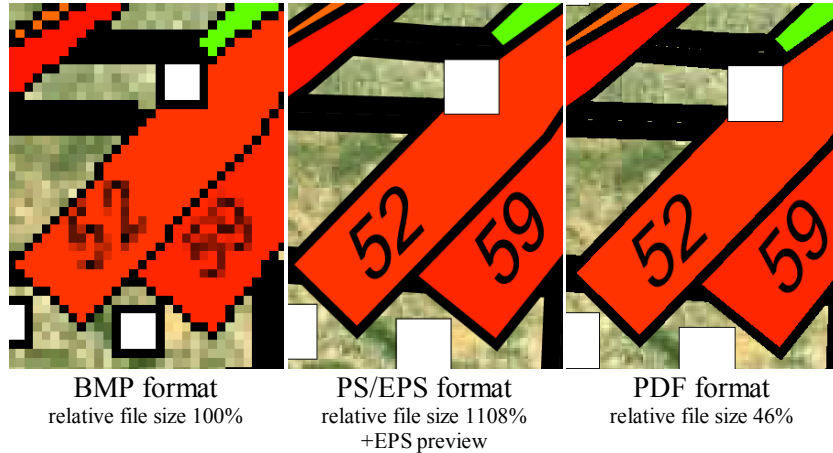
- **Portable Document Format**
 - PDF is a PostScript file interpreted by a RIP into objects
 - PDF can also contain printing instructions, keywords for searching/indexing, hyperlinks, animation, etc.
- **Advantages over (E)PS**
 - smaller file size
 - printing PDF does not require a PostScript printer
- **Disadvantage**
 - cannot insert PDF images into most report-creation software

Portable Document Format is an alternative format for PS files and EPS files. PDF can contain information related to how a page looks, and can describe how it behaves and what kind of information is contained in the file. A PDF file can contain fonts, images, printing instructions, keywords for searching and indexing, job tickets, interactive hyperlinks, movies, etc.

- Adobe Acrobat Reader (free) can print PDF to non-PostScript printers by interpreting the PDF file into that printer's language.

- Disadvantage of PDF: cannot insert PDF images into most report-creation software

Raster v. vector graphics



Vector graphics provide far better image quality due to unlimited scalability, which takes advantage of the best possible resolution of the output device.

The above PostScript graphic was generated with Enif using the Adobe PostScript Driver. The background satellite image yielded a PS file requiring over 10 times the storage capacity of the bitmap format. The other Enif sample plot (without a background photo) resulted in a relative file size equal to 43 when saved to PS. The conversion of PS to EPS has minimal impact on the file size. Adding a raster preview image can result in an arbitrarily larger EPS file.

The above PDF graphic was generated with Enif using FreePDF. The PDF format is of comparable quality to the PS/EPS format, with a much smaller file size. The other Enif sample plot resulted in a relative file size equal to 3.

Demonstration: Enif vector graphics

- Print an Enif plot to PDF
 - cannot easily include the PDF image in a report
- Print an Enif plot to PS
 - convert PS to EPS
 - add an EPS preview
- Insert the EPS image into a report
 - save the report to PDF format

To save a PS graphic in Enif in Windows (Appendix B)

- Select *Print full view* or *Print current view* from the *File* menu. Select the previously installed printer called "PostScript Generator". Check the *print to file* checkbox in the print manager. Specify a file name with extension ".ps" when prompted.

* If fonts do not scale properly or if fonts change when saved to a .ps file, you may not be using scalable fonts. Specify fonts that are TrueType or OpenType in the Enif Preferences.

Generating a PDF from Enif (Appendix A)

- In Enif, select *Print current view* or *Print full view* from the *File* menu, and select the previously installed printer called "FreePDF - Acrobat Distiller". Leave *print to file* unchecked. Click Print. Follow the instructions in the FreePDF dialog to save the PDF file.

Generating a PDF from any software:

- Select *Print* from the *File* menu, and select the previously installed printer called "FreePDF – Acrobat Distiller". Leave *print to file* unchecked. Click Print. Follow the instructions in the FreePDF dialog to save the PDF file.

Graphics format recommendations

- Printed reports should use vector graphics.
 - insert EPS images into the report
 - save the report to PDF
- Printed reports can use raster graphics
 - resolution for printing images (300-600dpi) leads to huge file sizes, so use PNG or convert to TIFF
- Web sites should use raster graphics
 - use PNG if possible
 - alternatively, use a limited color palette and convert from PNG/BMP/PPM/XPM to GIF
 - not recommended: JPEG

Although vector graphics are recommended for printed reports, if the report creation software cannot accommodate insertion of EPS images, then it is necessary to use raster graphics. See Appendix E for an example.

Tips for Enif output

- Plot size
 - Enif window
 - Enlargement factor
- Different screen and printer output
 - mapper flags
 - out-of-screen print legends
 - stylus pen width 0
- Print Preferences
 - applied only after a new session of Enif is opened

Now that we know how to output Enif plots to useful formats, how can we use Enif to obtain the images we want?

Plot size

- The network plane dictates the size and proportion of the exported image or printed plot.
- To reduce the plot size, you may need to hide parts of the Enif interface (in configuration mode) with Options > Show ...
- The tool tip of the pan panel displays the size of the view port.

Different screen and printer output

- Mapper flags can select whether or not the layer is displayed on the screen, in the magnifier, or when printed.
- Out-of-screen print legends are useful for including a title, a legend, or a logo outside of the printed plot frame.
- The stylus pen width 0 uses the minimal line width of the output device: 1 pixel on a screen or 1 dot on a printer.
- Check the printer output on the screen by printing to a *.ps* file and viewing the result with GSView.

Print Preferences

- applied only after a new session of Enif is opened

Appendix A: Generate PDF in Windows

- To generate a PDF graphic with Windows software install Adobe Acrobat (US\$249+) or follow the directions for Windows 9x/2000/XP to install (at no cost) and configure Redmon, FreePDF, and an Adobe PostScript Printer Driver at <http://www28.brinkster.com/freepdfsupport/>
 - Use GNU Ghostscript 7.05 since an error occurred when generating the PDF using FreePDF 0.98f with APFL Ghostscript 7.03, 7.04, and 8.00. APFL and GNU refer to copyrights. Both are free. See details at http://www.cs.wisc.edu/~ghost/doc/faq.htm#afpl_gnu
 - Download GNU Ghostscript 7.05 from <ftp://mirror.cs.wisc.edu/pub/mirrors/ghost/gnu/g705/>
 - See Appendix B for details on installing the Adobe PostScript Printer Driver.

Appendix B: Generate PostScript in Windows

- To generate a PostScript graphic in Windows install Adobe Acrobat (US\$249+) or install the Adobe PostScript Printer Driver free of charge as follows:
 - Download (at no cost) the *Adobe Universal PostScript Windows Driver Installer 1.0.6* and *PPD Files: Adobe* from www.adobe.com. Extract the *PPD Files: Adobe* archive to the hard drive.
 - The recommended system requirements refer to an installed PostScript printer, which proved unnecessary in our tests.
 - Install the Adobe PostScript Printer Driver locally on LPT1. Browse to *Acrobat Distiller* in the unzipped archive of PPD files to select the printer model. Name this printer "PostScript Generator".
 - Tests at INRO showed that the following was necessary to have the image printed on the PostScript printer: in the Printing Properties of the PostScript Generator printer, in the advanced options, in the PostScript Options, set the PostScript Output Option to *Encapsulated PostScript (EPS)*, and set the TrueType Font Download Option to *Bitmap*.
- All Windows software, including Enif for Windows, prints via the Windows Print dialog. Choose the PostScript Generator printer and check the *print to file* checkbox. Click Print. Specify the path and the file name with extension ".ps".
 - If fonts do not scale properly or if fonts change when saved to a .ps file, you may not be using scalable fonts. Specify fonts that are TrueType or OpenType in the Enif Preferences.

Appendix C: Convert PS to EPS in Windows

- To view a PS file, install Ghostscript and GSview. Visit <http://www.cs.wisc.edu/~ghost/>
 - See Appendix A for details.
- Converting PS to EPS in Windows:
 - Open the .ps file with GSView. From the *File* menu select *PS to EPS*. GSView can automatically select the bounding box, or you may specify it with mouse clicks. Specify a file name with extension “.eps” when prompted.
 - Open the .eps file with GSView. Select *Add EPS Preview* from the *Edit* menu and choose a format. Specify a different file name with extension “.eps” when prompted.

Appendix D: Generate EPS in Linux/Unix

- To save an EPS graphic from Enif in Unix/Linux
 - Select *Preferences* from the *Edit* menu. Select the *Print* tab and check the *Margins applied to full page* checkbox. This ensures that the output is portable and is not printer dependent, since printers have different printable areas.
 - Select *Print full view* or *Print current view* from the *File* menu. The output generated is EPS (1st line: `%!PS-Adobe-1.0 EPSF-3.0`).

Appendix E: Using raster images in reports

- If the report creation software cannot accommodate insertion of EPS images, then it is necessary to use raster graphics. The following tips will help.
 - The resolution of the generated image depends on the screen resolution. The screen resolution is 72 or 96 dpi (dots per inch). Check the screen resolution by exporting an image from Enif, then checking the resolution with an image editor. For example, open the image with Paint and select *Attributes* from the *Image* menu.
 - Use Enif's *Enlargement* factor in the *export plot to image file* dialog to generate an adequate number of pixels for good quality printing. Adequate print resolution is usually 300 to 600 dpi. If the required graphic measures 20 cm in width on the printed page at 300 dpi, it is necessary for the image to have a width of 2362 pixels. Adjust the Enif window so that the view port is 787 pixels wide according to the pan panel tool tip. Set the *Enlargement* factor to 3 when exporting the plot image from Enif.
 - To maximize print quality, avoid adjusting the resolution of the image. If it is unavoidable, adjust the resolution of the image with the report-creation software if possible, for example Quark Express. If the report creation software cannot adjust the image resolution, then use a graphics editing program to increase the resolution by resampling the image. Paint cannot perform this operation. Use Paint Shop Pro from Jasc or Adobe Photoshop or a similar software.