EMP:
Encapsulated METAPOST for LaTeX*

Thorsten Ohl†

Technische Hochschule Darmstadt
Schloßgartenstr. 9
D-64289 Darmstadt
Germany

May 31, 2008

Abstract

The EMP package allows to encapsulate METAPOST files in LaTeX sources. This is very useful for keeping illustrations in sync with the text. It also frees the user from inventing descriptive names for PostScript files that fit into the confines of file system conventions.

Copying

*This is `emp.dtx`, version v1.00, revision 1.10, date 1997/11/12.

†e-mail: `Thorsten.Ohl@Physik.TU-Darmstadt.de`

1 Introduction

When adding illustrations to documents, one faces two bookkeeping problems:

1. How to encourage oneself to keep the illustrations in sync with the text, when the document is updated?
2. How to make sure that the illustrations appear on the right spot?

For both problems, the best solution is to encapsulate the figures in the LaTeX source:

1. It is much easier to remember to update an illustration if one doesn't have to switch files in the editor.
2. One does not have to invent illustrative file names, if the computer keeps track of them.

Therefore EMP was written to allow to encapsulate METAPOST [1, 2] into LaTeX [2, 3, 4].
These macros have some overlap with `feynMF` [2, 5], `axodraw` [6] and `mfpic` [2, 7]. In fact, most of the functionality of EMP is available from `feynMF`. Longer pieces of METAPOST code are however not very conveniently typed in `feynMF`, because there is no facility for multi line input (using `\fmfcmd` with long arguments can overflow METAPOST's input buffers because of the missing line breaks). Since `feynMF` provides much syntax that is superfluous for EMP's purpose (the EMP package exports only five new environments and five commands), it is more appropriate to create a separate small package than to add this functionality to `feynMF`. Similar comments apply to `mfpic`.

2 Usage

2.1 Commands and Environments

`empfile` All descriptions that should go into one METAPOST file are placed inside a `empfile` environment which takes the name of the METAPOST file as an optional argument:

```
\begin{empfile}[⟨METAPOST-file⟩]
    ...
\end{empfile}
```

The default METAPOST-filename is `\jobname.mp`.

`emp` The `emp` environment contains the description of a single figure that will be placed at the location of the environment. Required arguments are the width and the height of the figure, in units of `\unitlength`. They will be available as the METAPOST variables `w` and `h`. The optional argument assigns a name to be used with `\empuse{`⟨*name*⟩`}`.

```
\begin{emp}[⟨name⟩](⟨width⟩,⟨height⟩)
    ⟨METAPOST-commands⟩
\end{emp}
```

Note that this environment uses the `verbatim` package to process the input lines and can therefore *not* be used as an argument to another macros. To work around this problem, you can first use the `empdef` environment and `\empuse` it later.

`\empuse` Reuse a previously defined figure.

`empdef` The `empdef` environment is similar to `emp`, but the figure is not drawn. This is useful, because these environments use the `verbatim` package and can therefore *not* be used as an argument to another macros.

```
\begin{empdef}[⟨name⟩](⟨width⟩,⟨height⟩)
    ⟨METAPOST-commands⟩
\end{empdef}
```

`empcmds` Write METAPOST commands to the current file outside of a figure.

```
\begin{empcmds}
    ⟨METAPOST-commands⟩
\end{empcmds}
```

`empgraph` The `empgraph` environment contains the description of a graph that will be placed a the location of the environment. The user is responsible for including the `graph` package by the using the command `\empprelude{input graph}` in the preamble. Required arguments are the width and the height of the graph, in units of `\unitlength`. They will be available as the METAPOST variables `w` and `h`. The optional argument assigns a name to be used with `\empuse{`⟨*name*⟩`}`.

```
\begin{empgraph}[⟨name⟩](⟨width⟩,⟨height⟩)
    ⟨METAPOST-commands⟩
\end{empgraph}
```

`\empTeX` Define a LaTeX prelude to be written to the top of every METAPOST file. The default is `\documentclass[`⟨*ptsize*⟩`]{article}`. If the prelude is not empty, `\begin{document}` will be added. Note that you have to run METAPOST as `TEX=latex mpost` ⟨*filename*⟩ if the prelude calls LaTeX.

`\empaddtoTeX` Add to the LaTeX prelude. E.g. `\empaddtoTeX{\usepackage{euler}}` makes sure that METAPOST will use the Euler fonts for the labels.

`\empprelude` Define and add to a METAPOST prelude to the top of every METAPOST file.

`\empaddtoprelude` The default is empty.

2.2 Examples

For a simple example, let's draw a smiling and a frowning face. Since they are identical except for the mouth, we prepare a macro for the common parts:

```
⟨*sample⟩
\begin{empcmds}
  vardef draw_face =
    pair lefteye, righteye, nose[];
    lefteye = c + (-0.25w,0.15h);  righteye = c + (0.25w,0.15h);
    nose1 = c - (0,0.05h);  nose2 = c + (0,0.15h);
    pickup pencircle scaled 1;
    draw fullcircle xscaled w yscaled h shifted c;
    draw fullcircle scaled 2 shifted lefteye;
```

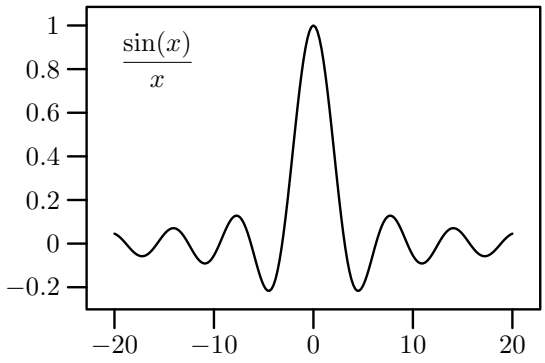

Figure 1: `graph` example.

```
    draw fullcircle scaled 2 shifted righteye;
    draw nose1--nose2;  draw mouth1..mouth2..mouth3;
    setbounds currentpicture to unitsquare xscaled w yscaled .5h;
  enddef;
\end{empcmds}
```

This can now be used for the frowning 

```
\begin{emp}(5,5)
  pair mouth[], c;  c = (0.5w,0);
  mouth1 = c + (-0.2w,-0.25h);
  mouth2 = c + (0,-0.2h);
  mouth3 = c + (0.2w,-0.25h);
  draw_face;
\end{emp}
```

and the smiling  face

```
\begin{emp}[smile](5,5)
  pair mouth[], c;  c = (0.5w,0);
  mouth1 = c + (-0.2w,-0.2h);
  mouth2 = c + (0,-0.25h);
  mouth3 = c + (0.2w,-0.2h);
  draw_face;
\end{emp}
```

Since we have given a name to `smile`, we can now use it with `\empuse{smile}`:

 Note that the reference point has been set up such that it works best as replacement for `\bullet` in `itemize` environments.

 This is very useful for slides.

As a second example, the simple plot of

$$j_0 = \frac{\sin(x)}{x} \tag{1}$$

is shown in figure 1:

```
\begin{empgraph}(60,40)
  pickup pencircle scaled 1pt;
  path p;
  for x = -20 step 0.2 until -0.2:
```

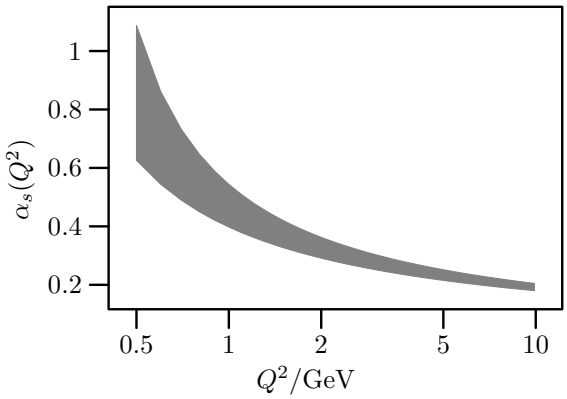

Figure 2: Another `graph` example.

```
    augment.p (x, sind(x*180/3.14159)/x);
  endfor
  augment.p (0, 1);
  for x = 0.2 step 0.2 until 20:
    augment.p (x, sind(x*180/3.14159)/x);
  endfor
  glabel.lrt (btex $$\displaystyle\frac{\sin(x)}{x}$$ etex, (-20,1));
  gdraw p;
\end{empgraph}
```

The command `\empprelude{input graph}` must have been put in the preamble to make the `graph` package available.
Finally, another application of the `graph` package:

$$\alpha_s(Q^2) = \frac{4\pi}{\beta_0 \ln(Q^2/\Lambda^2_{\mathrm{QCD}})} \tag{2}$$

with $\Lambda_{\mathrm{QCD}} \in [0.15\,\mathrm{GeV}, 0.25\,\mathrm{GeV}]$ and $\beta_0 = 11 - 2N_f/3$ is shown in figure 2:

```
\begin{empgraph}(60,40)
  pi = 3.14159; beta0 = 11 - 2/3*4;
  lambda1 = 0.15; lambda2 = 0.25;
  vardef ln expr x = (mlog x) / 256 enddef;
  vardef alphas (expr x, l) = 4*pi/(beta0*2ln(x/l)) enddef;
  setcoords (log,linear);
  pickup pencircle scaled 1pt;
  path p[];
  for x = 0.5 step 0.1 until 10:
    augment.p1 (x, alphas (x, lambda1));
    augment.p2 (x, alphas (x, lambda2));
  endfor
  gfill p1--(reverse p2)--cycle withcolor .5white;
  glabel.lft (btex $\alpha_s(Q^2)$ etex rotated 90, OUT);
  glabel.bot (btex $Q^2/\text{GeV}$ etex, OUT);
\end{empgraph}
⟨/sample⟩
```

Note that the `\text` macro of AMS-LaTeX has been used, therefore, the command `\empaddtoTeX{\usepackage{amsmath}}` must have been put in the preamble for this example to work.

References

[1] John D. Hobby, *A User's Manual for METAPOST*, Computer Science Report #162, AT&T Bell Laboratories, April 1992.

[2] Michel Goossens, Sebastian Rahtz, and Frank Mittelbach, *The LaTeX Graphics Companion*, Addison-Wesley, Reading MA, 1997.

[3] Leslie Lamport, *LaTeX — A Documentation Preparation System*, Addison-Wesley, Reading MA, 1985.

[4] Michel Goossens, Frank Mittelbach, and Alexander Samarin, *The LaTeX Companion*, Addison-Wesley, Reading MA, 1994.

[5] Thorsten Ohl, Comp. Phys. Comm. **90** (1995) 340; CERN Computer Newsletter **220** (1995) 22; **221** (1995) 46; **222** (1996) 24. `axodraw` is available from CTAN (cf. p. 6), in the `latex/contrib/supported` directory.

[6] Jos Vermaseren, Comp. Phys. Comm. **83** (1994) 45. `axodraw` is available from CTAN (cf. p. 6), in the `graphics` directory.

[7] Thomas E. Leathrum, `mfpic`, available from CTAN (cf. p. 6), in the `graphics` directory.

Distribution

EMP is available by anonymous internet ftp from any of the Comprehensive TeX Archive Network (CTAN) hosts

`ftp.tex.ac.uk`, `ftp.dante.de`

in the directory

`macros/latex/contrib/supported/emp`

It is also available from the host

`crunch.ikp.physik.tu-darmstadt.de`

in the directory

`pub/ohl/emp`

Unsupported snapshots of work in progress are provided as

`pub/ohl/emp.versions/emp-current.tar.gz`

3 Implementation

It's is good practice to identify this version of the document style option. We do this by parsing an RCS `Id` string and storing the result in the conventional TeX control sequences:

```
59 ⟨*style⟩
60 \def\fileversion{v1.00}
```

```
\NeedsTeXFormat{LaTeX2e}
{\def\RCS#1#2\endRCS{%
  \ifx$#1%
    \@RCS $#2 \endRCS
  \else
    \@RCS $*: #1#2$ \endRCS
  \fi}%
 \def\@RCS $#1: #2,v #3 #4 #5 #6 #7$ \endRCS{%
   \gdef\filename{#2}%
   \gdef\filerevision{#3}%
   \gdef\filedate{#4}%
   \gdef\filemaintainer{#6}}%
\RCS $Id: emp.dtx,v 1.10 1997/11/12 21:14:41 ohl Exp $ \endRCS}%
```

And now the standard procedure:

```
\ProvidesPackage{emp}[\filedate\space\fileversion\space
  Encapsulated MetaPost LaTeX Package (\filemaintainer)]
```

Every option we don't understand is sent down to `graphics`:

```
\DeclareOption*{\PassOptionsToPackage{\CurrentOption}{graphics}}
\ProcessOptions
\RequirePackage{graphics}[1994/12/15]
\RequirePackage{verbatim}
```

`\empwrite`

```
{\catcode`\%=11\gdef\p@rcent{%}}
\def\empwrite#1{%
  \if@empio
    \immediate\write\@outemp{#1}%
  \fi
  \ignorespaces}
\newif\if@empio
\@empiotrue
\newwrite\@outemp
```

`\empfile` This environment encloses each METAPOST input file. The single optional argument gives the name of the file.

```
\newcommand{\empfile}[1][\jobname]{%
  \def\theempfile{#1}%
```

Open the METAPOST file. If we're running under AMS-LaTeX, turn off I/O during the first pass over equation environments.

```
  \if@empio
    \@ifundefined{ifmeasuring@}%
      {}%
      {\def\if@empio{\ifmeasuring@\else}}%
    \immediate\openout\@outemp=\theempfile.mp\relax
    \empwrite{\p@rcent\p@rcent\p@rcent\space \theempfile.mp -- %
              do not edit, generated automatically by \jobname.tex}%
```

append `\begin{document}` to a non-empty `\LaTeX` prelude and write it out:

```
    \expandafter\ifx\expandafter*\the\emp@TeX*\else
      \emp@TeX=\expandafter{\the\emp@TeX^^J\begin{document}}%
      \empwrite{verbatimtex^^J\the\emp@TeX^^Jetex;}%
    \fi
```

```
    \expandafter\ifx\expandafter*\the\emp@prelude*\else
      \empwrite{\the\emp@prelude;}%
    \fi
  \fi
```

Count the figures

```
  \setcounter{empfig}{0}}
\let\theempfile\relax
\newcounter{empfig}
```

Standard preludes:

```
\newtoks\emp@TeX
\ifcase\@ptsize
  \emp@TeX={\documentclass[10pt]{article}}
\or
  \emp@TeX={\documentclass[11pt]{article}}
\or
  \emp@TeX={\documentclass[12pt]{article}}
\else
  \emp@TeX={\documentclass{article}}
\fi
\newtoks\emp@prelude
```

\empTeX
\empaddtoTeX
\empprelude
\empaddtoprelude

```
\def\empTeX#1{\emp@TeX={#1}}
\def\empaddtoTeX#1{\emp@TeX=\expandafter{\the\emp@TeX^^J#1}}
\def\empprelude#1{\emp@prelude={#1}}
\def\empaddtoprelude#1{\emp@prelude=\expandafter{\the\emp@prelude^^J#1}}
```

\endempfile

And here is how we close the `empfile` environment:

```
\def\endempfile{%
  \expandafter\ifx\expandafter*\the\emp@TeX*\else
    \empwrite{verbatimtex^^J\string\end{document}^^Jetex;}%
  \fi
  \empwrite{\p@rcent\p@rcent\p@rcent\space the end.^^J%
            end.^^J%
            endinput;}%
  \let\theempfile\relax
  \if@empio
    \immediate\closeout\@outemp
  \fi}
```

\emp

```
\newcommand{\emp}[1][*]{%
  \def\emp@@name{#1}%
  \emp@}
```

\emp@

```
\def\emp@(#1,#2){%
  \emp@start{#1}{#2}%
  \emp@includegraphics{\theempfile}{\theempfig}%
  \empcmds}
```

\emp@start

```
\def\emp@start#1#2{%
  \emp@checkfile
```

We can't use `\stepcounter` because of the `amstext` option of AMS-LaTeX disables it sometimes.

```
  \global\expandafter\advance\csname c@empfig\endcsname \@ne
  \emp@@def{\emp@@name}%
```

Start the METAPOST figure:

```
  \empwrite{beginfig(\theempfig);^^J%
                    LaTeX_unitlength := \the\unitlength;^^J%
                    w := #1*LaTeX_unitlength;^^J%
                    h := #2*LaTeX_unitlength;}}
```

\emp@checkfile Make sure that a METAPOST file is open, otherwise *really* obscure error messages are possible:

```
\def\emp@checkfile{%
  \ifx\theempfile\relax
    \errhelp={Outside a empfile environment, I have no clue as to where^^J%
              the MetaPost commands should go.   I will use empdefault.mp^^J%
              for this graph, but you'd better fix your code!}%
    \errmessage{I detected a emp environment outside of empfile}%
    \empfile[empdefault]
  \fi}
```

\emp@includegraphics

```
\def\emp@includegraphics#1#2{%
  \leavevmode
  \IfFileExists{#1.#2}%
    {\includegraphics{#1.#2}}%
    {\typeout{%
      emp: File #1.#2\space not found:^^J%
      emp: Process #1.mp with MetaPost and then %
           reprocess this file.}}}
```

\empcmds Write to the file:

```
\def\empcmds{%
  \begingroup
    \@bsphack
    \let\do\@makeother\dospecials
    \catcode`\^^M\active
    \def\verbatim@processline{\empwrite{\the\verbatim@line}}%
    \verbatim@start}%
```

\endempcmds

```
\def\endempcmds{%
    \@esphack
  \endgroup}
```

\endemp

```
\def\endemp{%
  \endempcmds
  \empwrite{endfig;}}
```

\empdef

```
\newcommand{\empdef}[1][\relax]{%
  \def\emp@@name{#1}%
  \emp@def}
```

\emp@def

```
\def\emp@def(#1,#2){%
  \emp@start{#1}{#2}%
  \empcmds}
```

\endempdef

```
\def\endempdef{\endemp}
```

\emp@@def

```
\def\emp@@def#1{%
  \global\e@namedef{emp@k:f:#1}{\theempfile}%
  \global\e@namedef{emp@k:c:#1}{\theempfig}}
\def\e@namedef#1{\expandafter\edef\csname #1\endcsname}
```

\empgraph

```
\newcommand{\empgraph}[1][*]{%
  \def\emp@@name{#1}%
  \emp@graph}
```

\emp@graph

```
\def\emp@graph(#1,#2){%
  \emp@start{#1}{#2}%
  \empwrite{draw begingraph (w, h);}%
  \emp@includegraphics{\theempfile}{\theempfig}%
  \empcmds}
```

\endempgraph

```
\def\endempgraph{%
  \endempcmds
  \empwrite{endgraph;^^Jendfig;}}
```

\empuse

```
\def\empuse#1{%
  \@ifundefined{emp@k:f:#1}%
   {\typeout{emp: \string\empuse: `#1' undefined!}}%
   {\emp@includegraphics{\@nameuse{emp@k:f:#1}}{\@nameuse{emp@k:c:#1}}}}
```

⟨/style⟩

Index

Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.

Change History

v1.00

General: Version 1.00 frozen. . . . 6

A Driver File

206 ⟨∗driver⟩
207 *\documentclass[a4paper]{article}*
208 *\usepackage{doc}*
209 *\usepackage{amsmath}*

The METAFONT and METAPOST logos come out much nicer if you have `mflogo` installed:

210 *\IfFileExists{mflogo.sty}%*
211 *{\usepackage{mflogo}%*
212 *\def\FMF{\texttt{feyn}\textlogo{MF}}%*

```
    \def\EMP{\textlogo{EMP}}}%
  {\def\MF{\textsf{META}\-\textsf{FONT}}%
    \def\MP{\textsf{META}\-\textsf{POST}}%
    \def\FMF{\texttt{feyn}\textsf{MF}}%
    \def\EMP{\textsf{EMF}}}
```

Protect against certain obsolete versions of the `graphics` package:

```
\usepackage{graphics}[1994/12/15]
\usepackage{emp}
\setlength{\parindent}{0pt}
\def\manindex#1{\SortIndex{#1}{#1}}
⟨manual⟩\OnlyDescription
\EnableCrossrefs
\RecordChanges
\CodelineIndex
\DoNotIndex{\def,\gdef,\long,\let,\begin,\end,\if,\ifx,\else,\fi}
\DoNotIndex{\immediate,\write,\newwrite,\openout,\closeout,\typeout}
\DoNotIndex{\font,\jobname,\documentclass,\char,\catcode,\ }
\DoNotIndex{\CodelineIndex,\DocInput,\DoNotIndex,\EnableCrossrefs}
\DoNotIndex{\filedate,\filename,\fileversion,\logo,\manfnt}
\DoNotIndex{\NeedsTeXFormat,\ProvidesPackage,\RecordChanges,\space}
\DoNotIndex{\begingroup,\csname,\edef,\endcsname,\expandafter}
\DoNotIndex{\usepackage,\@ifundefined,\ignorespaces,\item,\leavevmode}
\DoNotIndex{\newcounter,\newif,\par,\parindent}
\DoNotIndex{\relax,\setcounter,\stepcounter,\the,\advance}
\DoNotIndex{\CurrentOption,\DeclareOption,\documentstyle}
\DoNotIndex{\endgroup,\global,\hfuzz,\LaTeX,\LaTeXe}
\DoNotIndex{\macrocode,\OnlyDescription,\PassOptionsToPackage}
\DoNotIndex{\ProcessOptions,\RequirePackage,\string,\textsf,\unitlength}
\DoNotIndex{\@bsphack,\@esphack,\@nameuse,\@ne,\active,\do,\dospecials}
\DoNotIndex{\errhelp,\errmessage,\ifcase,\IfFileExists,\includegraphics}
\DoNotIndex{\manindex,\SortIndex,\newcommand,\newtoks,\or,\origmacrocode}
\DoNotIndex{\alpha,\displaystyle,\frac,\sin,\texttt}
```

Cut the line breaking some slack for macro code which might contain long lines (it doesn't really hurt if they stick out a bit).

```
\let\origmacrocode\macrocode
\def\macrocode{\hfuzz 5em\origmacrocode}
\begin{document}
  \DocInput{emp.dtx}
\end{document}
⟨/driver⟩
```