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Abstract

This paper documents the program Hcopy2PS that translates a Hcopy meta file to the page-description language PostScript, for printing e.g. on the Apple LaserWriter, and optionally prints it. A CTRL-C version named CC2PS is also presented.

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This paper documents the program Hcopy2PS that translates a Hcopy meta file to the page-description language PostScript, for printing e.g. on the Apple LaserWriter, and optionally prints it. A CTRL-C version named CC2PS is also presented.

1. Introduction

The programs Simnon, Idpac, Synpac etc., developed at the Department of Automatic Control, Lund Institute of Technology in Sweden, have a device independent hardcopy output called `hcopy meta`. Hcopy2PS is a program for translating hcopy meta files to the page description language PostScript [Adobe], to be printed on a PostScript device such as the Apple LaserWriter. A previous version was used in [Mårtensson1986a]. The PostScript file is "conforming", e.g. containing machine readable comments as described in [Adobe, Appendix C]. The PostScript file is a human readable text file, allowing inspection and modification with a standard text editor. This is further commented upon in Section 3.

In the last section, a CTRL-C version named CC2PS is presented. CTRL-C is a program for matrix computation etc. [CTRL-C]. CC2PS acts on CTRL-C's pen files.

The present paper is a reference manual, rather than a primer. It is not a hard program to handle, even though this paper seems frightenly long.

This paper is compatible with the version of Hcopy2PS that is dated October 6, 1986 and the version of CC2PS dated October 19, 1986. It is my intention that this paper should be updated when the programs are updated. They are approximately 600 lines long Pascal programs, and run under VAX/VMS version 4.x.

2. Function

Basic Operation

The program is run by the command `hcopy2ps`[/⟨*options*⟩] *file_name* where *file_name* is the name of the hcopy meta file. Default file-type is `p`. The file name can also be omitted, in which case the default file name is `meta.p`. By default, Hcopy2PS creates a PostScript file with the name *file_name.plo*. If the `print`-option is selected (which is default), the command "`@lwdriver` *file_name* is given to the operating system, which is supposed to print the file on a LaserWriter.

For the PostScript interpreter (e.g. in the LaserWriter) to understand the commands in the plot-file, the plot has to be preceeded by a short prolog file, containing definitions of the commands used by the plot. Unless told otherwise by different qualifiers (described in the next subsection) the prolog file `ps$inputs:plotdict.pro` will be prepended to the PostScript file.

Qualifiers

Next the different qualifiers will be described. They can be abbreviated as long as the abbreviations are unique.

`/print` *(Default)* `/noprint`

The `/print` option sends the PostScript file to the LaserWriter using the program LDRIVER. The PostScript file is deleted afterwards, regardless of the success of the printing.

`/portrait` *(Default)* `/landscape`

This selects portrait/landscape orientation of the page.

`/manualfeed`

This qualifier turns on the manual feeding on the LaserWriter. This can be used e.g for feeding letter-head paper, cardboard, and transparancies. This is, in contrast to the rest ot the commands, device dependent for the Apple LaserWriter, and will probably not be meaningful on other PostScript devices.

`/xoffset=`*x_offset* `/yoffset=`*y_offset*

These qualifiers allows the user to specify the x- and y-offset of the page, i.e. the distance between the lower left hand corner and the edges of the paper. Unit is mm, and no other unit is supported. Default is defined in the prolog used. The prolog presented in this report uses 10 mm for x- and 20 mm for y-offset. The qualifiers work in the same way both in portrait- and landscape mode. Needless to say, physical limitations restrict the meaningful values. Note that if a paper format other than A4 is used, the x- and y-offset will probably be off by a constant value.

`/magnification=`*magnification* `/height=`*height*

These qualifiers modify the magnification of the document. *magnification* is divided by 1000, e.g. `magnification=1200` means a magnification by a factor 1.2. *height* is the height of the whole plot-able area on paper.

These two qualifiers are just two different ways of expressing exactly the same thing. *magnification* = 1000 (which is default) corresponds to *height* = 124 (mm).

`/outfile=`*file_name*

This directs the output to the file *file_name*, instead of the default file, described above. The default file type is `plo`. Note that the command `hcopy2ps/outfile=a` *someone_elses_hcopy_metafile* will give a possibility for printing a hcopymeta-file residing on a directory on which you do not have write privileges.

`/noprolog` `/prolog=`*other_prolog_file*
The `noprolog` qualifier inhibits the prolog file to be included in the PostScript file. The `prolog` qualifier allows you to use another prolog than the standard one, if you for example want a non-standard pen-pattern.

`/alone` *(Default)* `/include`
The `alone` qualifier will make the file to print by itself by calling the PostScript operator `showpage` at the end of the file. `include` prohibits this, and is meant for plots intended for inclusion in other documents. (Note, however, that the latest version of the TEX DVI-handling program DVILW [Mårtensson 1986b] disables `showpage` in the `special` command and therefore makes it harmless to have a `showpage` too much in the file.)

`/horizontalfont="`*font_spec*`"` `/verticalfont="`*font_spec*`"` `/digitfont="`*font_spec*`"`

These qualifiers allows the user to use other fonts for the horizontal and vertical text, and for the digits. Note that the double quotes (") are mandatory. *font_spec* is of the form *font_name:font_size*, where *font_name* is the name of any font for the moment known to the PostScript device. A *font_size* of 0 is allowed, which will suppress all text in that font. This makes a very convenient way of getting rid of the sometimes annoying date and "hcopy `meta`" line by defining "`horizontalfont="a:0"`".

The LaserWriter Plus contains the resident fonts listed in Figure 1. The fonts marked with (*) are present also in the LaserWriter without "Plus". Note that the case of the letters is significant. (The list has been obtained by inquiring the LaserWriter directly, so it is guaranteed to be free of typos.)

font_size is a size of the font measured in bigpoints (bpt). It holds that 1 bpt = 1/72 inch. The default fonts are defined in the prolog file. The one presented in this report defines horizontal- and vertical font both to be 12 point Helvetica, and the digit-font to be 12 point Symbol.

Hcopy2PS considers a string of horizontal text as a digit string if it starts with a digit and the rest consists only of digits and the characters "." and "E". This is to allow both hyphens ("-") and minus-signs ("−") in the same plot. The only font resident in the LaserWriter that contains proper minus-signs instead of hyphens is "Symbol".

Conflicting options are allowed, in which case the rightmost of the conflicting qualifier takes effect. E.g. `/noprint/print` is equivalent to `/print`. This makes it possible for you to change defaults by defining e.g. `metaps == "''hcopy2ps/noprint'"`.

3. Hints, Tips, Discussion, Problems, and Possible Improvements

The PostScript file is a human readable text file, allowing inspection and modification with a standard text editor. This gives a vast freedom in editing the plots. It is e.g. very simple to locate and remove unwanted text (such as the date and the "hcopy" on the plot), change the scales, etc. A common problem is that lines know to be vertical

```
AvantGarde-Book
AvantGarde-BookOblique
AvantGarde-Demi
AvantGarde-DemiOblique
Bookman-Demi
Bookman-DemiItalic
Bookman-Light
Bookman-LightItalic
Courier (*)
Courier-Bold (*)
Courier-BoldOblique (*)
Courier-Oblique (*)
Helvetica (*)
Helvetica-Bold (*)
Helvetica-BoldOblique (*)
Helvetica-Narrow
Helvetica-Narrow-Bold
Helvetica-Narrow-BoldOblique
Helvetica-Narrow-Oblique
Helvetica-Oblique (*)
NewCenturySchlbk-Bold
NewCenturySchlbk-BoldItalic
NewCenturySchlbk-Italic
NewCenturySchlbk-Roman
Palatino-Bold
Palatino-BoldItalic
Palatino-Italic
Palatino-Roman
Symbol (*)
Times-Bold (*)
Times-BoldItalic (*)
Times-Italic (*)
Times-Roman (*)
ZapfChancery-MediumItalic
ZapfDingbats
```

Figure 1. List of PostScript names for LaserWriter Fonts.

comes out slanted in the plot. These can simply be "straightened up" in the PostScript file.

Scaling

The digits marking the scaling on the axis do not always occur in the right position. The hcopy meta file includes information about how wide etc. it considers its digit to be. This information is presently discarded, since the plotting routines never was done with high-quality typesetting in mind anyhow. Manual paste-up with a text editor is of course possible, and recommended for high-quality applications. (This was done in [Mårtensson, 1986a].)

Different Pens

Hcopy2PS knows of eight different pens that the hcopy plots might include. These eight different pens all have their own parameters for linewidth, dashing patterns, line-ends etc. These are not accessible as qualifiers in Hcopy2PS, but the prolog file can be edited in order to satisfy special needs or tastes.

The programs Simnon etc. draws with several pens in a fairly disoriented fashion—first it draws a little bit with one pen, then changes and draws a little with another pen, then changes back ... Hcopy2PS orders these paths so it only draws one single time with each connected curve drawn with the same pen. This makes dashed lines of high quality possible. However, due to an implementation limit in the LaserWriter, no path is allowed to consist of more than 1500 line segments. Therefore, Hcopy2PS will insert a break after 1400 line segments, which will occasionally disturb a dashed line.

4. Downloading plotdict

`plotdict` can either be loaded once for every plot sent to the LaserWriter printer, or it can be permanently downloaded. (Also note the possibility of "global" specials in the latest version of DVILW [Mårtensson 1986b].) The PostScript file in Figure 2 will permanently (i.e. until power-off) download `plotdict`.

Note that the new features in DVILW [Mårtensson 1986b] turns TEX into a powerful

```
0000
/#1 where
{pop pop(#1 in place - not loaded again\n)print flush stop}
{dup serverdict begin statusdict begin checkpassword
 {(#1 downloaded.\n)print flush exitserver}
 {pop(Bad Password on loading #1\n)print flush stop}ifelse
}ifelse
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Here comes the dictionary
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
(Finished downloading #1\n)print flush stop
```

Figure 2. PostScript Code for Downloading Plotdict

preprocessor for PostScript code, very suitable for creating files such as the one above.

5. An Example

As an example we show the plot on page 17 in [Åström]. This has been produced by the command `hcopy2ps/horizontal="ZapfChancery-MediumItalic:15"/ver="AvantGarde-Book:12"/noprint vdpol`. (The different scaling chosen on the axes is due to changes in the Simnon version.)

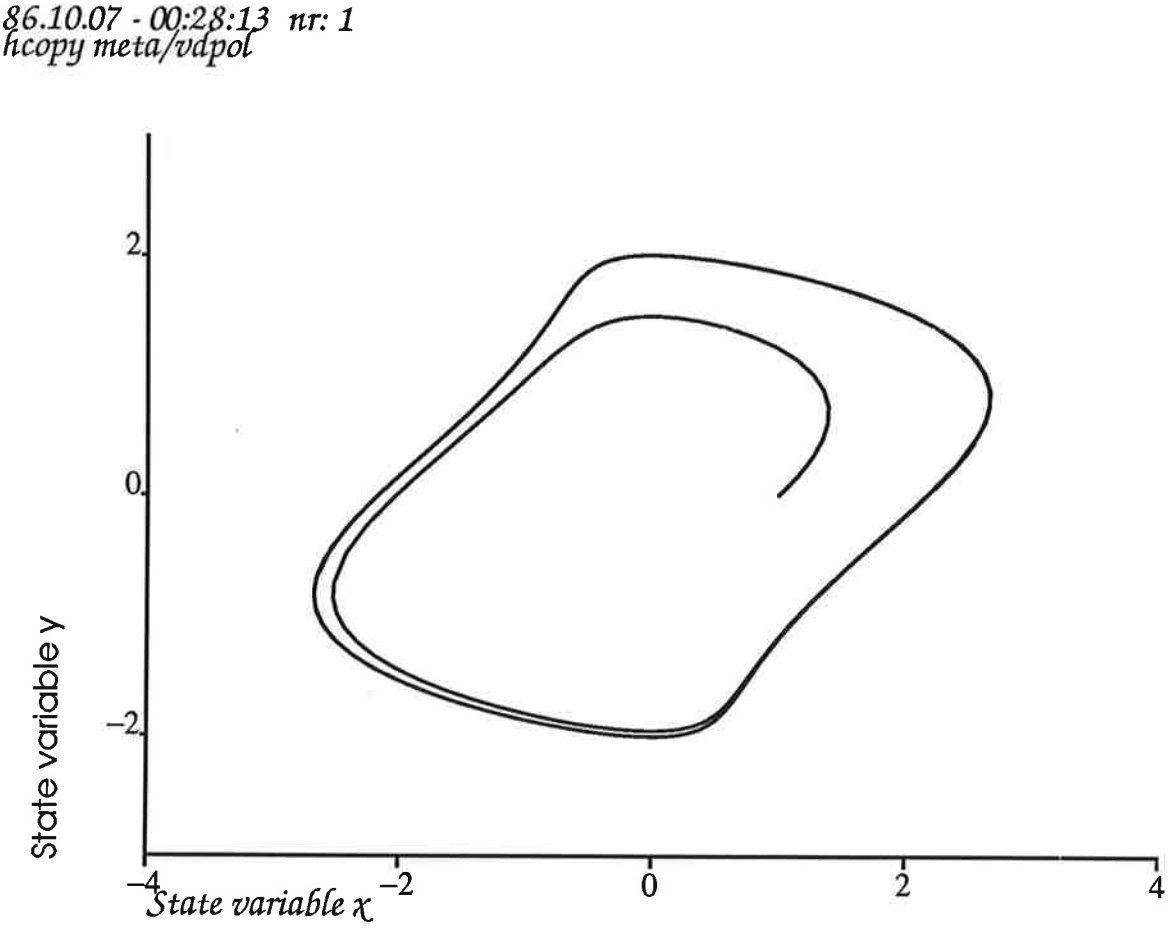

Figure 3. The figure on p. 17 in [Åström].

6. CC2PS—CTRL-C to PostScript Filter

CC2PS is a version of Hcopy2PS that produces PostScript code from CTRL-C's pen files. This is a program derived from Hcopy2PS by just some minor modifications. The operation and the qualifiers are all the same as for Hcopy2ps, even though some are meaningless, such as e.g. the font-selecting qualifiers.

Acknowledgements

CC2PS was created by using a template written by Mats Lilja. The command decoding part of the program has been stolen from Leif Andersson.

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Appendix. The dictionary PLOTDICT.PRO

This is the PostScript dictionary `plotdict.pro`. More esoteric plots can be achieved by modifying or rewriting the prolog.

```
%!PS-Adobe-1.0
%%Title: plotdict (new version)
%%CreationDate 86-10-06
/hcopy-dictionary 36 dict def
hcopy-dictionary begin
/print-page-when-done true def
/landscape false def

/window-height 124 def
/window-width  161 def
/x-offset 10 def
/y-offset 20 def

/d-font /Symbol def
/d-font-size 12 def
/h-font /Helvetica def
/h-font-size 12 def
/v-font /Helvetica def
/v-font-size 12 def

/pen-width-array
0.4
0.4
0.2
0.7
0.4
0.4
0.4

8
array
astore
def

/pen-cap-array
0
1
1
0
1
1
1
1

8
array
astore
def

/pen-dash-array
[]
[100 25]
```

```
        [100 25 25 25]
        []
        []
        []
        []
        []

        8
        array
        astore
        def

        /set-pen
        {
          1 sub
          dup dup
          pen-width-array
          exch
          get
          x-scaling div
          setlinewidth
          pen-cap-array
          exch
          get
          setlinecap
          pen-dash-array
          exch
          get
          0
          setdash
          1 setlinejoin
        } bind def

        /hcopy-begin
        { 0 0 moveto
        } bind def

        /hcopy-end
        { print-page-when-done
{showpage} if
        } bind def

        /hcopy-initialize
        { pop
          pop
          pop
          pop
          pop
          /iymax  exch def
          /iymin  exch def
          /ixmax  exch def
          /ixmin  exch def

          landscape {270 rotate -840
10 translate} if
          0 0 moveto
          72 25.4 div dup scale
          x-offset y-offset translate
          /x-scaling window-width
ixmax ixmin sub div
          def
          /y-scaling window-height
iymax iymin sub div
          def
          x-scaling y-scaling scale
          /true-h-font
            h-font findfont
            h-font-size 72 div 25.4
mul y-scaling div scalefont
          def
          /true-v-font
            v-font findfont
            v-font-size 72 div 25.4
mul x-scaling div scalefont
          def
          /true-d-font
            d-font findfont
            d-font-size 72 div 25.4
mul x-scaling div scalefont
          def
        } bind def

        /d
        { set-pen
          moveto
          true-d-font setfont
          show
        } bind def

        /h
        { set-pen
          moveto
          true-h-font setfont
          show
        } bind def

        /v
        { set-pen
          moveto gsave currentpoint
translate 90 rotate
          true-v-font setfont
          show grestore
        } bind def

        /s
        { set-pen
          stroke
        } bind def

        /l { lineto } bind def
        /m { moveto } bind def
        /n { newpath } bind def
        end
```