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Experiences With Computerized Document Preparation Tools

Abstract

This paper summarizes the author's experience with computerized document preparation tools over the last year. In particular, it describes the production of the authors Ph.D. thesis "Adaptive Stabilization". Also producing viewgraphs, producing class problems, and writing letter is covered. The involved programs etc. are TeX, PostScript (implemented e.g. in the Apple LaserWriter), Macintosh—in particular MacDraw, Simnon, EMACS, and some additional programs, written or modified by the author. This report is a case-study of the use of TeX etc. for the production of a major work—"Adaptive Stabilization". Also, some TeX-macros and some programs are presented. These are believed to be useful as such, they present some ideas, and it is hoped that they will serve as a source of inspiration.

Key words

Classification system and/or index terms (if any)

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Bengt Mårtensson, November 5

Abstract: This paper summarizes the author's experience with computerized document preparation tools over the last year. In particular, it describes the production of the authors Ph.D. thesis "Adaptive Stabilization". Also producing viewgraphs, producing class problems, and writing letter is covered. The involved programs etc. are TeX, PostScript (implemented e.g. in the Apple LaserWriter), Macintosh—in particular MacDraw, Simnon, EMACS, and some additional programs, written or modified by the author. This report is a case-study of the use of TeX etc. for the production of a major work—"Adaptive Stabilization". Also, some TeX-macros and some programs are presented. These are believed to be useful as such, they present some ideas, and it is hoped that they will serve as a source of inspiration.

1. Introduction

Today the use of computers has opened up a vast amount of new possibilities for document preparation. Computerized type-setting programs such as TeX, [Knuth], Scribe, [Unilogic], and Troff [Unix] produce, according to many peoples opinion, typesetting of the same or higher quality as traditional typesetting.

Since the last few years, word processing has been fairly widely used, mainly because of the great efficiency. For this efficiency, quality requirements have been sacrificed. The output of simple word processors (see e.g. the reports, thesises etc. produced at this department a few years ago) have held a quality far below typed text.

Fortunately, with typesetting programs such as TeX, the efficiency of the word processer can be combined with output of typeset quality. However, since typesetting contains so many more bells and whistles than ordinary typing, it necessarily has to be harder to learn. It is harder to fly a jumbo-jet than to ride a bicycle.

Since a photo-typesetter hardly can be considered as a low-cost device, laser printers offer a good, medium-price alternative for output.

This report will document some of my experience with the computerized document preparation tools I have used the last year. In particular, this concerns the production of my Ph.D. thesis "Adaptive Stabilization" [Mårtensson 1986a], but also producing viewgraphs, producing class problems, and writing letter is touched upon. The involved programs etc. are TeX, the page description language PostScript [Adobe], (implemented e.g. in the Apple LaserWriter), Macintosh—in particular MacDraw, Simnon

[Åström], the editor EMACS (both Gosling's and GNU, [Stallman]), and some additional programs, written or modified by myself.

This report serves several purposes: First, it is a case-study of the use of TeX etc. for the production of a "major work" ("Adaptive Stabilization"). Secondly, some TeX-macros are presented. These are believed to be useful as such, they present some ideas, and I hope that they will serve as a source of inspiration for the development of macros at my department. They represent experience gathered from the production of the presently technically most advanced work at the department.

This is a fairly unorganized report. It is absolutely not a tutorial of TeX. For the outcome of the different examples shown, the reader is referred to "Adaptive Stabilization".

The work has been carried out on a VAX 11/780 running VMS, although the Unix world has served as a source of inspiration.

Possibly this report can also be somewhat of a starting point for creating documentation of the entirely undocumented beast you get by writing tex on the department's computer.

For these reasons, all details will not be covered to the same level of depth. What I considered as less mature, where I probably would have done differently today, or I consider much work remains to be done, is covered very briefly, or not at all. More developed ideas or features, which I hope are of more "universal" interest, will be given more emphasis. The goal is in general to describe "the spirit", rather than to write a reference manual. Also, as a documentation of some macros etc., it might possibly contain more errors than is usual (for me!).

This is a personal paper, describing—as the title indicates—my experiences and my opinions rather than being a reference manual. (For this reason, I will call myself "I", not "the author".)

Very much of the work presented here is really the outcome of a fairly collective effort at the department. What I present here as "my" macros or programs is most often something that has been around in many hands, where the last bells and whistles might be pulled by myself. It is a hard, and not really meaningful, task determine who has done so and so much. Several names of my colleagues at the department will be mentioned in the sequel. I am greatly indebted to them. Apart from these, I would also like to thank Prof. Karl Johan Åström, Eva Dagnegård, and Doris Nilsson for discussions which have been very inspiring for me.

General Philosophy

It was a new, highly laborious, but also highly rewarding experience for me to write a Ph.D. thesis, and to do it with the powerful, but—I dare to say—a bit low-level like tools provided by PlainTeX. I had a good start in "Bookmacro" by Leif Andersson. Since I wanted to take full advantage of every aspect the new technique had to offer, I wanted it to help me, not make things harder. The macros and the programs were developed for both providing output of a very high quality, for allowing me all the "traditional"

advantages of text-processing, but also—which is perhaps was the most intellectually challenging part of it—to develop methods for creatively working on writing scientific, mathematical text while letting the computer help you with a fair amount of the dog-work you do yourself when writing with pencil and paper. This includes cross references to theorems, formulas, bibliography; numbering of sections, formulas etc., etc. It should also be easy to make global changes by just changing at one place, for example if you want a special symbol to denote the end of a proof or a remark, the way you want your theorems numbered etc. When working on a piece of the size of a Ph.D. thesis; since you are not exactly writing all of it at the same time, this turns out to be very important. A major theme in the work presented in this report is to create macros etc in a fashion that lets you postpone the decisions of the final outcome until the last minute.

For these reasons—together with the terrific feeling of superior control over your own work: *We authors should* not *leave computerized typesetting to neither secretaries nor programmers.*

Sections 2–9 are devoted to the TEX tools used to produce "Adaptive Stabilization". The main structure of "Adaptive Stabilization" is presented in the next section. Sections 3–4 describe the chapters, sections, theorems, etc. The log file, cross references, the table of contents, and the index is covered in Sections 5–8. Section 9 describes the bibliography.

Section 10 treats verbatim sections, and Section 11 describes slide production. Letter writing is covered in Section 12. Some of my experiences with the Emacs editor and the Macintosh is collected in Sections 13–14. TEX macron for producing final exams are presented in Section 15. Section 16 describes the DVI handling program DVILW very briefly. In Section 17 I describe some of my experiences with PostScript. Finally, Section 18 contains everything that I could not fit any other place.

Appendix 1–4 contain all macros described. Appendix 5 consists of the documentation of the program DVILW.

Note. *The escape-character of TEX, "\" in Plain TEX, has been replaced by "!". Furthermore, begin-group and end-group ("{" and "}" in PlainTEX) are replaced by "<" and ">".*

This replacement is a department standard. The reason for this replacement is that everywhere in Sweden, except for this department, the Swedish characters "å", "ä", and "ö" in some contexts are represented as "{" etc. For several different reasons, I consider the choice of "!" as very unfortunate.

The section on students problems also contains an example of Swedish language "source code" (typeset with the `teletype` font) for TEX. In these, "å", "ä", "ö", "Å", "Ä", and "Ö" will be represented as "}", "{", "|", "]", "[", and "\".

2. The T_EX-structure of "Adaptive Stabilization"

The T_EX-format used has been called Thesmacro. This will be described in the sequel. It is based on a much shorter core, "Bookmacro", written by Leif Andersson. The help I had from these is gratefully acknowledged.

It should be noted that my intentions never where to make Thesmacro a "user-friendly" product, but only good enough for producing "Adaptive Stabilization". In particular, the file should be extensively cleaned up to be presentable.

The file thesmacro.tex is found in extenso in Appendix 1. It should be noted that it also uses some (fairly non-critical) macros that has been around at the department, essentially replacing the escape-character and the begin- and end-group characters of PlainT_EX, and fiddling around with some fonts. It also defines the macros !sveaa, !sveae, etc. which expands to the national Swedish characters. More importantly however, is that Thesmacro is prepended by the macros in $\mathcal{A}_{\mathcal{M}}\mathcal{S}$-T_EX. It does not depend heavily on them however.

Below, I will in general not make explicit references to where in the code A or B is done, but rather describe its working. The reason for this was given above.

3. Chapters, Sections, etc.

The main file for "Adaptive Stabilization" is shown below. It is called thesis.tex

```
%%%%%%%%%%%%%%% Thesis %%%%%%%%%%%%%%%%%%%%%%
% LastEditDate="Sun Feb 23 23:16:23 1986"
!finalversion
!inputxrefs
!let!settalky=!relax
!let!canon=!relax
!let!goodbye=!relax
!let!inputxrefs=!relax
% !input [.preamble]firstpage
% !input [.preamble]secondp
!pageno=-5
!input [.preamble]preamble
!beginfirstchapter
!pageno=1
!chapno=0
!input [.1intro]ch1
!input [.2pform]ch2
!input [.3tools]ch3
!input [.4meta]ch4
!input [.5general]ch5
!input [.6highgain]ch6
!input [.7conc]ch7
```

```
!endlastchapter
!input [.refs]refs
!input [.index]index
!bye
```

Only the major features will be commented upon here. As can be seen from the file, the successive chapters are input from this file. "LastEditDate" has been automatically updated by the EMACS editor. !finalversion will inhibit the generation of external files, and eliminate some notes in the margins of the pages. This command is, as the name indicates, used only to process the very final version of the manuscript. !inputxrefs will read the file thesis.xre containing cross-reference information. The treatment of external files and these two commands will be further discussed later.

Thesmacro includes the statement !let!goodbye=!bye, making !goodbye a synonym for !bye. Every chapter file is finished with !goodbye. The statment !let!goodbye=!relax in the file above will make !goodbye an empty statement. This arrangement will allow the chapter files both to be processed by themselves, and without modification be included in the full book. The lines

```
!let!goodbye=!relax
!let!inputxrefs=!relax
```

are for multichapter processing. The second line is because we do not want the forthcoming chapters to read in a file of cross-reference information. !beginfirstchapter and !endlastchapter are described in the context of generation of the table of contents.

For a typical chapter, Chapter 3, the file ch3.tex looks as follows:

```
!chapno=2
!finalversion!pageno=23
!chapter <Some General Tools>
!note<File name:>
!note<use:[bengt.dirs.universal.thesis.3tools]ch3.tex>
% LastEditDate=
!note<dated "Mon Feb 24 15:51:08 1986">
!inputxrefs
!input use:[bengt.dirs.universal.thesis.3tools]intro
!input use:[bengt.dirs.universal.thesis.3tools]dynamicfb
!input use:[bengt.dirs.universal.thesis.3tools]scllemma
!input use:[bengt.dirs.universal.thesis.3tools]timevar
!input use:[bengt.dirs.universal.thesis.3tools]switch
!input use:[bengt.dirs.universal.thesis.3tools]conc
!endchapter
!goodbye
```

This file inputs different files for the different sections. The !chapter-command starts a new chapter, and !endchapter ends it. As can be seen, I have assigned a number to the numerical registers chapno and pageno "the brutal way". Of course, this is very ugly and really not necessary for multi-chapter processing. However, it allows the processing of Chapter 3 by itself, while still the page-numbers will come out as in the full book. Warning: ⟨This is left as an exercise to the reader...⟩

There are the command !section, !subsection, and !subsubsection, start new sections etc, and all functioning in analogous ways. All will get automatically numbered. For reasons of uniformity, also the chapters are automatically numbered. By now, I consider the latter as over-doing it slightly. !chapter and !section will affect the running headlines on the left- and right-hand pages respectively.

Compare the use of !inputxrefs and !goodbye with what has been said above. When ch3.tex is processed by itself, inputxrefs will look for a file with the name ch3.xre.

The !note-command will write its argument in the margin of the page, and write into a log-file. It is disabled by !finalversion. Note the use of the automatic updating of "LastEditDate" in order to get this date in the margin of the paper.

For the table of contents, the preface, the index, and the reference list ("chapters without a name") I have invented the (slightly silly?) term "lambdachapter". This alludes to λ-definitions in the programming language LISP, which gives possibility to define a function without giving it a name. The !lambdachapter command starts a "lambdachapter". It should be ended by !endchaper. There is also the command !lambdasection.

4. Theorems, Remarks, Proofs, etc

Theorems, propositions, remarks, figures, all have a general structure. Proclaims (i.e. theorems, corollaries, lemmas, propositions etc.) are written with a !proclaim-macro, similar to the one found in PlainTEX, but with the same syntax as $\mathcal{AMS}$-TEX. I.e. the proclaim text is ended by !endproclaim. The command !enumeratetheorem will provide automatic numbering of all theorems. There are also the commands enumeratelemma, !enumerateproposition, !enumeratecorollary, !enumerateremark, !enumeratedefinition, and !enumerateexample. It turned out that I finally decided to make them all synonymous, except for !enumerateremark—but this illustrates the important point made in the section on general philosophy.

There are also the macros !definition, !remark, !example, !proof, !assumption, and !notation, starting paragraphs of a certain type. They will also write their name in a particular font.

All proofs are ended by !qed; all remarks are ended by !endremark. Similar statements hold for definitions, assumptions, notations, and examples.

5. The Log File

The commands !note, !reference, and !index all write in the log-file, which gets the name thesis.log.

The !note command was described above. The !reference command will enclose its arguments in square brackets, and write it into the log-file. The !index command will

also write in the log file and in the margin. This is meant for entries to go into the index.

Below the first part of the file `ch1.log` is shown. The "L" lines are created by the `!note`-command, the "R" by the `!reference`-command, while the "I" lines are the entries which should go into the index. The number following the letter is the page on which the entry occurs.

```
L 1   File: "[...1intro]ch1.tex", dated
L 1   "Sun Feb 23 19:23:49 1986"
I 1 : adaptive control
I 1 : ASEA
I 1 : Foxboro
R 1   !accent '27 Astr!accent "7F om! 1983
I 1 : !astrom , K. J.
I 1 : learning controller
```

6. Cross References

Thesmacro contains a very elaborate system for cross references to numbered theorems, sections, chapters, etc. and the pages on which they occur. (A cross reference system for bibliography has not been used, but can be easily constructed. See the section on references.) It is very simple to use: The following excerpt from page 81 in "Adaptive Stabilization" shows how to assign a label to anything that is automatically enumerated.

```
!proclaim Lemma !enumeratelemma.
!label<unitarylemma>
Let $Q$ be a unitary matrix.  !index<Unitary matrices> The
following three properties are then equivalent:
!item<(i)> $!sp Q !subset !cplus$
!item<(ii)> $| Q - I|!< !sqrt 2$
!item<(iii)> $Q + Q^* !> O$
!endproclaim
```

The `!proclaim` macro is similar to the one of PlainTEX, but require that the proclaim text to be delimited by `!endproclaim` (just as in $\mathcal{A}_{\mathcal{M}}\mathcal{S}$-TEX). `!enumeratelemma` does exactly what the intelligent reader expects, in this case it expands to "6.3". These commands where described in a previous section. Then the command label<unitarylemma> will assign the label *unitarylemma* to it. What this command really does is to write on the cross reference file `thesis.xre`. This file is listed below.

This cross reference information is later (in the present case on page 83) recalled as

```
where the last inequality used Lemma !xref<unitarylemma>.  The
claim and the lemma follows.
!qed
```

(`!qed` is a macro that just expands to a filled square. I have found this a very practical philosophy for writing: End all your proofs with the macro `!qed`, then you can

afterwards, for all occurences simultaneously, decide what it should do (e.g. nothing). Of course, this applies to so much more than how to end proofs. However, I have no hope that the WYSIWYG (What-You-See-Is-What-You-Get) people will ever appreciate this.)

Page references are also possible: The following is from page 79:

```
In Chapter~3 we built two powerful tools, Theorem
!xref<tvsptheorem>, page !pageref<tvsptheorem>, on
time-varying singularly perturbed
systems, and Theorem !xref<switchingfunctiontheorem>, page
!pageref<switchingfunctiontheorem>, on switching function based
controllers.
```

The file `thesis.xre` contains the cross-reference information. The part corresponding to Chapter 6 looks as:

```
!filelabel<nistwoexample> <6.1> <81>
!filelabel<finiteunmixingproposition> <6.2> <81>
!filelabel<unitarylemma> <6.3> <81>
!filelabel<normallemma> <6.4> <82>
!filelabel<polardecomposition> <6.5> <82>
!filelabel<OPlemma> <6.6> <83>
!filelabel<eulertheorem> <6.9> <86>
!filelabel<productlemma> <6.11> <87>
!filelabel<philemma> <6.12> <88>
!filelabel<unmixingtheorem> <6.13> <88>
!filelabel<reldeg1stabilization> <6.14> <91>
!filelabel<sisoplusplantset> <6.4> <92>
!filelabel<polystabilizationproposition> <6.16> <93>
!filelabel<sisostabilizationproposition> <6.17> <95>
!filelabel<multihighreldegstabilizer> <6.18> <96>
!filelabel<ballandbeamsection> <6.5> <98>
```

TEX makes an `!input` on this file, and `!filelabel` is just a command defined in Thesmacro. Note the format: first the label comes (say *label*), then what it shall be translated into by `!xref<label>`, and finally the page on which it occurs, which will be available as `!pageref<label>`.

By this arrangement, forward references are just as easy as backward references. The drawback is that it is a pure two-pass system, no references at all, not even backward references, are found on the very first pass. (With some additional effort, this can of course be fixed. LaTEX has—I have been told—this feature.)

7.   The Table of Contents

The commands `!chapter`, `!section`, `!subsection`, `!subsubsection`, its lambda-siblings, `!caption`, `!beginfirstchapter`, and `!endlastchapter` will all write on the TOC- (Table Of Contents) file. This file gets the name `thesis.toc`. Below the beginning and the end of this file is shown.

```
!TOClambdachapter <> <Preface> <vii>
!TOClambdasection <> <Outline> <vii>
!TOClambdasection <> <Intentions> <viii>
!TOClambdasection <> <The Production of This Thesis> <viii>
!TOClambdasection <> <Acknowledgements> <ix>
!TOCbeginfirstchapter <> <> <xi>
!TOCchapter <1> <Adaptive Control> <1>
!TOCsection <1.1> <Adaptation, Learning, Self-organizing, Self-tuning>
<1>
!TOCsubsection <> <Learning Machines> <2>
!TOCsubsection <> <Adaptive Controllers as Learning Machines> <3>
!TOCfigure <1.1> <> <3>
!TOCsection <1.2> <Approaches to Adaptive Control> <4>
!TOCsubsection <> <Model Reference Adaptive Control, MRAC> <4>
!TOCsubsection <> <Self-Tuning Regulators, STR> <4>
!TOCfigure <1.2> <> <5>
!TOCsubsection <> <Gain Scheduling> <5>
!TOCfigure <1.3> <> <6>
!TOCsubsection <> <Self Oscillating Adaptive Systems, SOAS> <6>
!TOCsubsection <> <Dual Control> <6>
!TOCsection <1.3> <The Classical Assumptions of Adaptive Control> <6>
!TOCsubsection <> <The 'Counterexamples' to Adaptive Control> <7>
!TOCsection <1.4> <The Necessity of the Assumptions---Universal Controllers>
<8>
!TOCsection <1.5> <Multi-layer Control> <9>
!TOCsection <1.6> <Adaptive Control---A Viewpoint> <10>
!TOCsection <1.7> <Control Theory, Engineering, and Mathematics> <11>
!TOCsubsection <> <On this Thesis> <12>

...

!TOCchapter <7> <Conclusions and !unskip !penalty 10000! !ignorespaces
Suggestions for !unskip !penalty 10000! !ignorespaces Further Research> <101>
!TOCsection <7.1> <Introduction> <101>
!TOCsection <7.2> <Extensions and Discussion> <102>
!TOCendlastchapter <> <> <105>
!TOClambdachapter <> <References> <105>
!TOClambdachapter <> <Index> <109>
```

First a TEX macro call is written, consisting of the letters "TOC", followed by the name of the invoked macro. Then its number, name, and starting page follows. One or more of these fields are empty for some entries.

Below the file contents.tex is shown, generating the table of contents.

```
%%%%%%%%%%%%%%%%%%% Contents %%%%%%%%%%%%%%%%%%%%%%%%%
!note<File "[...preamble]contents.tex", dated>
!begincontents
% LastEditDate=
!note<"Sun Feb 23 14:53:11 1986">
```

```
%
!lambdachapter <Contents>
% !tracingmacros=1!tracingcommands=1
!input use:[bengt.dirs.universal.thesis]contents.in
% Renaming of THESIS.TOC
!endcontents
!endchapter
```

As can be seen, it inputs the file contents.in, which was meant to be a simple re-editing of thesis.toc. It turned out that, because of a bug I never fixed, the table of contents itself never occured in thesis.toc, so I was entirely satisfied with it and just renamed it to contents.in. (I don't think that this should be considered the normal situation, though.)

The philosophy is to create a TOC-file, as complete as possible, and then, when deciding the final style, give meaning to the TOC-commands, !begincontents, and !endcontents. For example, Thesmacro defines !TOCsubsubsection and !TOCfigure to be void, because I did not want these as entries in the table of contents.

Note that a table of figures can easily be generated from the TOC-file.

8. Index

The log-file has been described above. It contains the entries that are meant for the index. Out of this file, the index-program produces the file index.in, of which the beginning and the end is shown below. The file has been slightly hand-edited, e.g. the page intervals are fixed up manually, some entries commented out, and negative pagenumbers replaced by roman numerals (unfortunately erroneously). The !sub commands have also been inserted manually. Cf. page 109 in "Adaptive Stabilization".

```
!newletter<A>
 adaptation problem, 2
 adaptive control, 1--12
!sub classical assumptions of, 7
!sub convergence of, 17, 18
!sub counterexamples to, 7
!sub model reference, 4, 17
!sub nec. and suff. conditions for, 9
!sub parameter, 4
 adaptive controller, 2
!sub as learning machine, 3
!sub as non-linear controller, 16
!sub parameter space of, 3, 16
!sub state space of, 3, 16
% adaptive control problem, 19
!sub problems as set relation, 19
```

```
!sub safety net for, 8
!sub supervisory loop for, 8
 Aizerman, M. A., 29
 Aizerman's conjecture, 29
 $!aleph _0$, 14
 almost $(A,B)$-invariant subspaces, 60
 almost periodic functions, 67
 !AmSTeX, iv
 Anderson, B. D. O., 47
 Andersson, L., iv
 anti-periodicity requirement, 69
 Anton, J., 9
 Apple, iv
 artificial intelligence, 2, 9, 10
 !arzen , K.-E., 9
 ASEA, 1, 8
 associated switching points, 40
 Assumption Bounded Required Gain, 21, 74
 Assumption Simple Null Structure, SNS 21, 95
% Assumption SNS, 21
% Assumption ''Bounded Required Gain'', 74
 !astrom , K. J., iv, 1, 9, 36, 60
 Athans, M., 7
 augmented plant, 24, 41, 58, 67, 75
% autotuner, 9
 autotuning, 9, 36
 averaging techniques, 4
!newletter<B>
 ball and beam, 98, 103
```

The index is typeset in two-column format. An output routine very similar to Appendix E in the TEXbook has been used. However, the bug there, reported in [TUGBOAT] has been fixed as in the latter paper.

This is the file index.tex, that generates the index:

```
%%%%%%%%%%%%%% Index %%%%%%%%%%%%%%%%%%%%%%%%
%
!finalversion
!pageno=109
!note<File: "[...index]index.tex", dated>
% LastEditDate=
!note<"Mon Feb 24 05:06:57 1986">
!lambdachapter<Index>
%
!beginindex
!input use:[bengt.dirs.universal.thesis]index.in
!endindex
!endchapter
```

```
!goodbye
```

The Index Program

The index program used is a modification of a VAX/VMS Pascal program that has been around at the department for many years. It was originally written for the departments word processing program Report. As can be seen from above, it sorts the entries and inserts the !newletter-commands.

It is my opinion that this program should be replaced rather than documented.

The index in "Adaptive Stabilization" is very simple. In my opinion, a "smart" index-program should contain the following features.

* Handling primary references, to be typeset e.g. in boldface.

* Handling one or two other "sorts" of references, to be typeset differently; cf. the index in The TeXbook.

* Handle spans of pages, such as 31–34, in the different "sorts".

* Hierarchical references, on several levels.

* "*See*" and "*See also*".

Probably the best way to implement a smart index program will be to write it in GNU-EMACS-Lisp. An interesting paper on smart index programs, containing TeX macros and Lisp code is [Winograd-Paxton].

There are in principle two different philosophies of making indexes in computer typeset books: "Dumb" index programs, doing not very much more than sorting, and "smart" index programs, as outlined above. (Note that these terms have nothing to do with the intelligence of the user.) Using a "dumb" index program is advocated by D. E. Knuth in The TeXbook: "The author prefers not to generate indexes automatically; he likes to reread his books as he checks the cross-references, thereby having the opportunity to rethink everything and to catch miscellaneous errors before it is too late. As a result, his books tend to be delayed, but the indexes tend to be pretty good. Therefore he designed the indexing scheme of manmac to provide only the clues needed to make a real index." I would only like to make the comment that using a "smart" index program probably will let you put this information into the source-file instead.

9. Bibliography

Writing bibliography correctly is hard. The user should be helped by carefully designed macros for this purpose. It should also make it possible to make global changes of the appearance of the reference list—there are so many different styles in the journals etc. around. The one I have used are a modification of the ones used in $\mathcal{AMS}$-TeX. Leif Andersson has also been involved in the modification. Below a very short guide of their

use will be given. The reader is refered to "Adaptive Stabilization" for the outcome of the examples.

The bibliography section is begun with the command
```
!references
```
and ended with the command
```
!endreferences
```

For the logic, !references should really have been called !beginreferences instead.

Next I discuss the different entries. Most important is to know what kind of animal we are dealing with, in order to decide whether it should go into the aquarium or the zoo. A book is not a conference paper. (A gorilla is not an octopus.) I will devote different subsections to different animals. All examples are real examples taken from "Adaptive Stabilization".

Books

Books are the easiest entries. Below is the correct reference to one of my favorites.
```
!bref Ahlfors, L.~V.
!yr 1979
!book Complex Analysis
!publ McGraw-Hill
!publaddr New York
!endref
```

All references start with !bref and ends with !endref. The name of the author follows immediately after !bref, as above. !yr denotes the year; note that sometimes e.g. !yr 1979a might be appropriate. !publ and !publaddr provides the publisher and the publication address. Finally, !book tells that the animal is a book, and what the title is.

Before proceeding, here is what is common for all entries: The different macros may occur in any order, except for !bref and !endref. A reference macro (such as !book) will consider everything that follows up to the next reference macro as its argument (in the case of book the book title). Thus there is no need for enclosing it in begin-end-group pairs.

The macros !yr, !publ, !publaddr are almost always included (unless you write papers with uncomplete reference list). However, they are optional, and no barfing occurs if they are left out.

Paper in a Journal

This is a correct reference to a paper in a journal:
```
!bref Byrnes, C. I. !and P. K. Stevens !yr 1982
!paper The McMillan and Newton Polygons of a Feedback System and the
Construction of Root Loci
!jour Int. J. Control !vol 35 !issue no. 1 !pages 29--53
```

```
!endref
```

The !paper command should be used for "papers", i.e. parts of a book, a journal etc. !jour signals that it is a journal with a volume number (!vol), an issue number (!issue), and pagenumbers (!pages). It should be noted that there is also a !page macro available for contributions at most one page long. Also note the use of !and.

Paper in an Edited Book

A paper in an edited book is shown below:
```
!bref Brockett, R. W.
!paper Asymptotic Stability and Feedback Stabilization
!yr 1983
!book Differential Geometric Control Theory
!inref Brockett, R.~W., R.~S. Millman, !and H.~J. Sussmann,  !eds
!publ Birkh!sveae user
!publaddr Boston
!endref
```

Note !inref and !eds, the latter one giving the name of the editors. Also !ed is available. Papers in conference proceedings should also be written in this way, possibly without !eds, and most likely with !pages. Cf. the example below by A. S. Morse.

Reports etc.

Reports etc. is written as !report:
```
!bref Rohrs, C.
!yr 1982
!report Adaptive Control in the Presence of Unmodeled Dynamics
!publ Dept. of Elec. Eng. and Computer Sciences, M.~I~.T.
!publaddr Cambridge, MA
!reportinfo Ph.D. Thesis
!endref
```

Note the use of !reportinfo. Also !finalinfo and !toappear are available. (One person I know of argues that, since in his opinion references to unpublished material should be abandoned altogether, macros for writing it should not be available either.)

Edited Book in a Series

This is the hardest one in "Adaptive Stabilization"—It is a conference paper in an edited book, contained in a series:
```
!bref Morse, A.~S.
!yr 1983
!paper Recent Problems in Parameter Adaptive Control
!book Outils et Modeles Mathematiques pour l'Automatique, l'Analyse
de Systemes et le Traitement du Signal
!inref Landau, I.~D. !ed
```

```
!jour Editions du CNRS !vol 3 !pages 733--740
!endref
```

Additional Macros

I have also used several macros on a slightly higher level, denoting my area's most important conferences, journals etc. The idea is that you just once in you lifetime should have to bother about the correct way of referring to the CDC -82 conference, etc.

This is an entry in "IEEE Transactions on Automatic Control":
```
!bref Brockett, R.~W. !and C.~I. Byrnes
!yr 1981
!AC <Multivariable Nyquist Criteria, Root Loci, and Pole Placement:
A Geometric Viewpoint> 26 1 271--284
!endref
```

Below, a CDC -83 paper:
```
!bref Byrnes, C.~I. !and B.~D.~O. Anderson
!CDCeightythree <On the Stabilizability of Multivariable Systems by
Minimum Order Compensation> 1358--1362
!endref
```

One of my internal reports at the department:
```
!bref !bysame
!CODEN <Pascal Systems in Simnon> 7278 14 1984
!yr 1984a
!endref
```

Note !bysame.

I believe that macros of this type is a novel use of the possibilities opened up by the modern technology.

Finally, here is the core of the file reference.tex creating the reference list. All entries are deleted, since their structure have been described above. In particular, note the command !references (should really have been called !beginreferences) which starts the reference list, and the command !endreferences, ending it.
```
% % % % % References % % % % % % % %
!finalversion!pageno=105
!note<File: "[...refs]refs.tex", dated>
% LastEditDate=
!note<"Mon Feb 24 14:49:56 1986">
%
!lambdachapter<References>
%
!references
!tolerance=2000
!viiipt
!def!CDCeightytwo #1 #2 <!paper #1!yr 1982
```

```
   !book Proceedings of the 21st
   IEEE Conference on Decision !& Control
   !publaddr Orlando, FL
   !pages pp. #2>
!def!CDCeightythree #1 #2 <!paper #1!yr 1983
      !book Proceedings of the 22nd IEEE Conference
   on Decision !& Control
   !publaddr San Antonio, TX
   !pages pp. #2>
!def!CDCeightyfour #1 #2 <!paper #1!yr 1984
   !book Proceedings of the 23rd IEEE Conference
   on Decision !& Control
   !publaddr Las Vegas, NV
   !pages pp. #2>
!def!ACCeightyfive #1 #2 <!paper #1!yr 1985
   !book Proceedings of the 1985 American Control
   Conference
   !publaddr Boston, MA
   !pages pp. #2>
!def!MTNS #1<!paper #1!yr 1985
      !book Proc. 7th International Symposium on the
      Mathematical Theory of Network and Systems
      !inref Byrnes, C.~I. !and A.~Lindquist !eds
      !publ North Holland
      !publaddr Amsterdam>
!def!INRIA #1 #2 <!paper #1!yr 1984
   !book Proc. INRIA Conf. on Analysis and
   Optimization of Systems
   !jour Lecture Notes in Control and Information Sciences
   !issue 62
   !pages #2
   !publ Springer-Verlag !publaddr Berlin>
!def!Automatica #1 #2 #3 #4 <!paper #1!jour Automatica !vol #2
      !issue no. #3 !pages #4>
!def!AC #1 #2 #3 #4 <!paper #1!jour  IEEE Transactions on Automatic Con-
trol
      !vol AC-#2!issue no. #3!pages #4>
!def!SCL #1 #2 #3 #4<!paper #1!jour Systems !& Control Letters !vol #2
      !issue no. #3!pages #4>
!def!thedepartment<!publ Dept. of Automatic Control,
   Lund Institute of Technology
   !publaddr Lund, Sweden>
!def!CODEN #1 #2 #3 #4 <!report #1!yr #4
 !thedepartment
 !reportinfo Report CODEN:
LUTFD2/!discretionary<><><>(TFRT-%
```

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```
  !discretionary<><><>#2)/%
  !discretionary<><><>1--#3/%
  !discretionary<><><>(#4)>
%
...........................
...........................
%
!endreferences
!endchapter
!goodbye
```

A Possible Cross Reference System

Actually, it is possible to do cross references to bibliography with the presented macros just as they stand: Just write, say,

```
!def!ident<!martensson! 1986a>
!label<MyPhDThesis>
```

or

```
!def!ident<4>
!label<MyPhDThesis>
```

at the appropriate place in the bibliography. Then you can write

```
... the ingenious work !reference<!xref<MyPhDThesis>>, (see the
reference list on page !pageref<MyPhDThesis>).
```

Of course it is possible to very simply streamline the use by some additional simple macros, and/or some modifications of the reference macros.

Possible Improvements

Cross references built into the system has been discussed above.

Some entries does not have a natural author. The author entry is mandatory in the presently used system. How do you e.g. write The Bible in the list of references? A possibly less far-fetched item, is found in the reference list of this paper, namely the Unix programmers manual.

Some publishers require tags such as "[4]" instead of names. The present system does not support this, which must be taken into account for writing manuscripts for such publishers.

A forgotten !endref etc. makes TeX go haywire. It is possible to build into the definition of !bref and !endref a check to see that they are properly nested, and issue a warning on the terminal if this is not the case.

This marks the end of the description of the TeX-part of "Adaptive Stabilization". The next sections will present some other TeX-stuff I have been using during the last year.

10. Verbatim Sections

The TeXbook, page 421, describes a macro for verbatim sections, such as the ones type-set with the `teletype` font in this paper. The one given below is a slight modification of that one by Leif Andersson and myself. Knuth's function does not respect several consecutive blank lines, which the one given below does. For the working, the reader is referred to The TeXbook.

```
!chardef!other=12   % App E p 421
!newdimen!verbatimindent!verbatimindent=2em
!let!verbatimpt=!xpt
!def!ttverbatim<!begingroup !parskip=0pt!parindent=!verbatimindent
!hfuzz=100mm
!catcode'!!=!other !catcode'!<=!other
                !catcode'!>=!other !catcode'!$=!other !catcode'!&=!other
                !catcode'!#!other !catcode'!%=!other !catcode'!~=!other
                !catcode'!_=!other !catcode'!^=!other
                !def !par<!leavevmode!endgraf>%
                !obeyspaces!obeylines
                !verbatimpt!tt!strut>
!catcode'!|=!active
!def|<!ttverbatim!let|=!endgroup>
<!obeyspaces!global!let =! >
!def!verbinput #1 <!smallbreak !bgroup!obeylines!catcode'!|=!other!ttverbati
    !input #1 !endgroup!egroup!smallbreak>
!def !ttbar<<!tt !char'!|>>
```

`!verbinput` allows the verbatim input of an file, in a way such that not even "|" needs escaping. (Actually, this is exactly how the list above was produced—self reference!)

11. Slides

This section will describe a format for making TeX-generated slides. A short core for this was written by Leif Andersson. It is by no means a "finished product", but I have had a great help of it anyhow.

Below is the beginning of the file describing the first three slides I used for presenting [Mårtensson 1986d] in August this year.

```
!input slides
%
!def!Matrix #1<!left!lgroup!matrix<#1>!right!rgroup>
% !finalversion
%
% Titlepage
%
!begintitleslide
```

```
!begintitle
Dynamic High-Gain Stabilization
of Multivariable Linear
Systems, with Application
to Adaptive Control
!endtitle
!author <Bengt M!aa rtensson>
!theaddress
!endtitleslide
%
!begincontentsslide
Introduction
% The case sp CB in C+
The Unmixing Problem
% n=2,3
% Euler angles solution
High-Gain Stabilization of Scalar Plants of Arbitrary Relative Degree
Multivariable plants
Adaptive Stabilization
An Example %
!endcontentsslide
%
!beginslide <Introduction>
!heading <Introduction>
Consider the square, minimum phase plant
$$
!align
!dot x &= Ax + Bu !qquad x !in !realR^n!qquad u !in !realR^m!cr
y &= Cx !quad y !in !realR^m!cr
!endalign
!eqno<!rm (MIMO)>
$$
where $!sp CB !subset !complexC^+$  and all its zeros are in the
left half plane. By root locus, for $k !in !realR$ large the
control law
$$
u = -ky
$$
will stabilize (MIMO).

<!bf Adaptive version:> The controller
$$
!align
u &= -ky !cr
!dot k &= !|y!|^2
!endalign
```

```
$$
stabilizes all plants satisfying the above requirements.

<!bf Want to generalize these results in two directions:>
!item<(i)> $!det CB !not=0$
!item<(ii)> ''Higher relative degree''
!endslide
```

The three slides resulting from this file are shown in Figures 1–3. The TEX macros are shown in Appendix 2.

Every slide is started with !beginslide and ended with !endslide. The argument to !beginslide is written to a log-file, but not used otherwise. The rest of the shown commands are hopefully self-explaining. Note that it is mandatory to end the last line of the "contentsslide" with a "%". This should preferably be removed in the future.

!finalversion inhibits the numbering of the slides and the dates on them; see Figures 1–3.

The LaserWriter can be feed by over-head film directly. The program DVILW supports this by the /manualfeed qualifier. These slides are a fair amount more crisp than making plastic copies of your paper printouts.

It has been my experience that my computer generated slides tend to be better to its contents than my hand written. You get a better chance of planning the slides, you can re-do an almost-good slide, you are not tempted to write too much on each slide, or to use that annoying extra little free area in the upper right hand corner. However, last-minute changes can be hard: At a hotel room thousands of mile from home, it might pose you problems of getting access to, say, your favorite computer running your favorite operating systems, TEX, your favorite text editor, and a PostScript device taking over-head film. On the other hand, this encourages you to be prepared better in advance, so you can spend the night before your talk in the nightclub drinking whisky instead of making slides.

It should be pointed out that these macros do not work properly with the departments official TEX since the changes in September. The conversion is in principle easy, though.

12.   Letters

The last six months or so I have done all my letter writing in TEX with the format described below. It is a development of the letter format described in Appendix E of The TEXbook. Also Jan Eric Larsson has done some modifications.

For the mening of the commands the reader is referred to The TEXbook. Below a "source-file" for a letter is shown. The output, on the departments letter head paper, is shown in Figure 4. The automatically generated address label is shown in Figure 5. The macro file is listed in Appendix 3.

Dynamic High-Gain Stabilization of Multivariable Linear Systems, with Application to Adaptive Control

Bengt Mårtensson

Department of Automatic Control
Lund Institute of Technology
Box 118, S-221 00 Lund
Sweden

Figure 1.

Contents:

* Introduction

* The Unmixing Problem

* High-Gain Stabilization of Scalar Plants of Arbitrary Relative Degree

* Multivariable plants

* Adaptive Stabilization

* An Example

Figure 2.

Introduction

Consider the square, minimum phase plant

$$\dot{x} = Ax + Bu \qquad x \in \mathbb{R}^n \qquad u \in \mathbb{R}^m$$
$$y = Cx \quad y \in \mathbb{R}^m \qquad\qquad \text{(MIMO)}$$

where $\mathrm{sp}\, CB \subset \mathbb{C}^+$ and all its zeros are in the left half plane. By root locus, for $k \in \mathbb{R}$ large the control law

$$u = -ky$$

will stabilize (MIMO).

Adaptive version: The controller

$$u = -ky$$
$$\dot{k} = \|y\|^2$$

stabilizes all plants satisfying the above requirements.

Want to generalize these results in two directions:

(i) $\det CB \neq 0$

(ii) "Higher relative degree"

Figure 3.

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```
% LastEditDate="Wed Nov  5 17:27:36 1986"
!magnification=1200
!input busletter
!input addresses
!BMletterhead
!address
!JanWillems
!body
Dear Professor Willems,

This is a letter protesting agains superflous letters. Not only do
they say nothing, the say it over and over again. In particular
computer generated letters, which makes it even easier to use a lot of
words for saying absolutely nothing. Not only do they say nothing, the
say it over and over again. They keep repeating these meaningless
phrases over and over again. Such as: Not only do they say nothing,
the say it over and over again. I think it is time to stop this. Some
letters would have been better unsent. Not only do they say nothing,
the say it over and over again.

!closing
Best regards,

!BM
!endletter
!makelabel
!bye
```

Dr. Bengt Mårtensson
Department of Automatic Control
Lund Institute of Technology
Box 118, S-221 00 LUND, Sweden

Prof. Jan C. Willems
Mathematics Institute
University of Groningen
P. O. Box 800
9700 AV Groningen
THE NETHERLANDS

Figure 5. The Address Label.

Note the !input addresses which will input the file addresses.tex, which reads:
```
!begingroup
```

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Bengt Mårtensson
Int-46-46-108790
UUCP:. . .!mcvax!enea!agaton!bode!bengt

November 5, 1986

Prof. Jan C. Willems
Mathematics Institute
University of Groningen
P. O. Box 800
9700 AV Groningen
THE NETHERLANDS

Dear Professor Willems,

This is a letter protesting agains superflous letters. Not only do they say nothing, the say it over and over again. In particular computer generated letters, which makes it even easier to use a lot of words for saying absolutely nothing. Not only do they say nothing, the say it over and over again. They keep repeating these meaningless phrases over and over again. Such as: Not only do they say nothing, the say it over and over again. I think it is time to stop this. Some letters would have been better unsent. Not only do they say nothing, the say it over and over again.

Best regards,

Bengt Mårtensson

Figure 4. The Sample Letter.

25

```
!obeylines
!gdef!JanWillems<%
Prof. Jan C. Willems
Mathematics Institute
University of Groningen
P. O. Box 800
9700 AV Groningen
THE NETHERLANDS
        >

. . . . . . . . . . . . . .
!endgroup
```

In this way, I only have to write down the address one "in a lifetime" for every person I would like to send letters to. I have let this file reside on my private tex$inputs. This is discussed in the section on loose ends.

The macros presented in The TEXbook does not work in the claimed way for multi-page letters. At the time of this writing, I *think* that mine can take two-page letters, but not more.

This letter format has been very helpful for me. Possibly it would have been better to insert the date manually, rather than automatically, because of documentation purposes.

It would also have been nice to have the letter automatically folded, the label glued to the envelope, and the envelope licked automatically.

It should be pointed out that these macros do not work properly with the departments official TEX since the changes in September. The conversion is in principle easy, though.

13. Emacs

When I started to work on "Adaptive Stabilization" I used the TEVE/PEVE editor by Leif Andersson, with enhancements by Per Persson. Later I changed to an Emacs editor, Gosling's. Lately, we have got access to GNU Emacs, [Stallman], to which I am totally converted. I have found that my productivity increases drastically when using a more powerful editor. When it comes to producing TEX-material, the syntactical errors have decreased to a small fraction.

Emacs, also GNU, is a child in the Unix family. The VMS version of GNU Emacs is not as good as the Unix version, but amazingly close.

I have—with a great help from Mats Lilja and Kjell Gustafsson—modified the TEX-mode delivered with GNU Emacs to fit both own standard of escape characters, and VMS. It works, and it is a really beautiful tool!

The department's own world-unique standard of representing the national Swedish characters is however a never ending source of irritation for me, since no editor but TEVE/PEVE understands this, and our terminals does not support anything else.

Automatic Spelling Correction

To run **spell** inside an editor and correct the spelling mistakes interactively in it is a much more efficient way of working than running **spell** off line. Gosling's Emacs has a very neat interactive spelling correction, which I modified heavily to fit into the VMS and TₑX environment. In particular, the private word-list is a terrific feature. At the time of this writing, I am almost finished porting these modifications to GNU Emacs.

14. Experiences of Macintosh, especially MacDraw

The block diagrams etc. in "Adaptive Stabilization" started their life in MacDraw. I soon found out that the quality of the output simply was not acceptable, the arrows were awful, it was next to impossible to get things properly aligned, to write something like

$$C \left(sI - A\right)^{-1} B$$

in a box in an acceptable way was simply not possible. (I have seen MacDraft in action, and it is only marginally better.) Therefore, PostScript code was generated by the Ctrl-F method, this code was "Kermit-ted" to the VAX, and heavily manually edited. (I had a very great help with this by Mats Lilja.) A prolog-file, consisting of PostScript definitions necessary, was prepended to the file, and inserted into the total file.

In my opinion, it is a shame that Apple does not support generating PostScript code by the Macintosh. Its usefulness would increase drastically. The prolog file has been changed very often in Apple's very frequent updates. I think the present version has number 49!

15. Student's Problems

I also have written formats for students problems, i.e. final exams and problem sets. I am faily satisfied with the format for the finals, but there is much to be done when it comes to a rational handling of problem banks. Probably this should be combined with some sort of data-base.

Below is the beginning of the source text of a final exam given in August this year.

```
% LastEditDate="Mon Aug  4 18:14:32 1986"
!input tentamac
!finalversion
!begintitlepage
!examtitle<Reglerteknik AK f|r M>
!examdate <25 Augusti 1986> 8--13
!examresult
Resultatet ansl}s m}ndagen den 15 september 1986 p} institutionens
anslagstavla p} f|rsta v}ningen i Maskinhuset.
```

Visning samma dag kl 12.00--12.30 i labbet p} f|rsta v}ningen.
!endtitlepage
%
!problem
Betrakta f|ljande tre system
!subproblem a
$$
G(s) = <1 !over <(s+1)(s+2)>>
$$
!subproblem b
$$
G(s) = <1 !over <s^2 - s + 1>>
$$
!subproblem c
$$
G(s) = <1 !over <s^2 + 2 s + 1>> e^<- 2 s>
$$
L}t insignalen till systemen vara $u(t) = 4 !sin 3t$. Avg|r, i de
fall det {r meningsfullt, vad den station{ra utsignalen blir f|r
stora t, dvs n{r transienten d|tt ut.
!points 3
%
!problem
Scandust i Landskrona har en plasmaprocess f|r att }tervinna metall
ur skrot. I processen genereras ett plasma genom en
ljusb}gsurladdning i en l{mplig gas. Processen kan
beskrivas med det f|renklade schemat i figur !nextfigure.
!figure <F|renklat processchema.> <75 truemm>

En matematisk modell av processen beskrivs av
$$
L <<dI> !over <dt>> = U - V(I)
$$
d{r U {r den p}tryckta sp{nningen och $V(I)$ {r
sp{nningen |ver urladdningsr|ret. Induktansen hos spolen L
{r 0.005 H. Funktionen $V(I)$ kan approximeras med
$$
V(I) = a+be^<-cI>
$$
d{r $a = 2$ kV, $b = 10$ kV och $c = 0.05 !hbox<A>^<-1>$.

Betrakta systemet som ett dynamiskt system med str|mmen I som
tillst}nd och utsignal, samt sp{nningen U som styrvariabel.
Linj{risera systemet kring arbets!-punkten $I = 20$ A. [r det
linj{riserade systemet stabilt?
!points<2>

28

```
%
!problem
Den linj{riserade modellen f|r processen i uppgift !previousproblem!
kan beskrivas med |verf|rings!-funktionen
$$
G(s)= <!beta !over <s - !alpha>>
$$
d{r $!alpha !> O$ och $!beta !> O$. Best{m en PI-regulator s}
att det slutna systemet har f|ljande karakteristiska ekvation
$$s^2 + 2 !zeta !omega s + !omega^2 = O$$
Vad {r det minsta v{rdet p} f|rst{rkningen som ger ett
stabilt system?

(Tips. Du kan l|sa detta tal {ven om du missat problem
!previousproblem. Det {r dock ett plus att ha riktiga
sifferuppgifter.)
!points<2>
%
!problem
En PID-regulator med begr{nsad derivatadel
har |verf|ringsfunktionen
$$
G(s) = K !left(1 + <1 !over <T_i s>> +
<<T_d s> !over <<<T_d> !over N> s + 1>>!right)
$$
Skriv $G(s)$ p} tillst}ndsform.
!points<2>
%
!problem
Betrakta  blockschemat i figur !nextfigure!!
% !vskip -6mm
!figure <Blockschema f|r uppgift !thisproblem.> <100truemm>
% bblo13nr2.pr> <100mm> < >
% !vskip -40mm
!special <ffblock.plo>
!subproblem<a>
Antag att $G(s)=< <1> !over <s+3>>$ och $H(s)$ {r
en PI-regulator. S{tt $K_f=O$ och best{m $K$ och $T_i$ s}
att det slutna systemets poler hamnar i $-2 !pm 2i$.
!points 1
!subproblem<b>
I det slutna systemets |ver!-f|rings!-funktion
upptr{der ett nollst{lle. Ta bort detta genom att v{lja den
konstanta framkopplingen $K_f$ l{mpligt.
!points 1
```

The output is shown in Figures 5, 6, and 7. Note the automatic numbering of the

Institutionen för Reglerteknik
Tekniska Högskolan i Lund

Reglerteknik AK för M

Tentamen 25 Augusti 1986 kl 8–13

Poängberäkning och betygsättning

Lösningar och svar till alla uppgifter skall vara klart motiverade. Tentamen omfattar
totalt 25 poäng. Poängsättningen finns markerad vid varje uppgift.

Betygsgränser:

Betyg 3 : högst 12 poäng
    4 : högst 17 poäng
    5 : högst 22 poäng

Tillåtna hjälpmedel

Matematiska tabeller (TEFYMA eller motsvarande), formelsamling i reglerteknik
samt icke förprogrammerade räknare.

Tentamensresultat

Resultatet anslås måndagen den 15 september 1986 på institutionens anslagstavla
på första våningen i Maskinhuset. Visning samma dag kl 12.00–12.30 i labbet på
första våningen.

Figure 5.

1. Betrakta följande tre system

a)

$$G(s) = \frac{1}{(s+1)(s+2)}$$

b)

$$G(s) = \frac{1}{s^2 - s + 1}$$

c)

$$G(s) = \frac{1}{s^2 + 2s + 1}e^{-2s}$$

Låt insignalen till systemen vara $u(t) = 4\sin 3t$. Avgör, i de fall det är meningsfullt, vad den stationära utsignalen blir för stora t, dvs när transienten dött ut. (3 p)

2. Scandust i Landskrona har en plasmaprocess för att återvinna metall ur skrot. I processen genereras ett plasma genom en ljusbågsurladdning i en lämplig gas. Processen kan beskrivas med det förenklade schemat i figur 1.

Figur 1. Förenklat processchema.

En matematisk modell av processen beskrivs av

$$L\frac{dI}{dt} = U - V(I)$$

där U är den påtryckta spänningen och $V(I)$ är spänningen över urladdningsröret. Induktansen hos spolen L är 0.005 H. Funktionen $V(I)$ kan approximeras med

$$V(I) = a + be^{-cI}$$

där $a = 2$ kV, $b = 10$ kV och $c = 0.05\text{A}^{-1}$.

Figure 6.

31

Betrakta systemet som ett dynamiskt system med strömmen I som tillstånd och utsignal, samt spänningen U som styrvariabel. Linjärisera systemet kring arbetspunkten $I = 20$ A. Är det linjäriserade systemet stabilt?   (2 p)

3. Den linjäriserade modellen för processen i uppgift 2 kan beskrivas med överförings-funktionen

$$G(s) = \frac{\beta}{s - \alpha}$$

där $\alpha > 0$ och $\beta > 0$. Bestäm en PI-regulator så att det slutna systemet har följande karakteristiska ekvation

$$s^2 + 2\zeta\omega s + \omega^2 = 0$$

Vad är det minsta värdet på förstärkningen som ger ett stabilt system?

(Tips. Du kan lösa detta tal även om du missat problem 2. Det är dock ett plus att ha riktiga sifferuppgifter.)   (2 p)

4. En PID-regulator med begränsad derivatadel har överföringsfunktionen

$$G(s) = K\left(1 + \frac{1}{T_i s} + \frac{T_d s}{\frac{T_d}{N}s + 1}\right)$$

Skriv $G(s)$ på tillståndsform.   (2 p)

5. Betrakta blockschemat i figur 2!

Figur 2. Blockschema för uppgift 5.

Figure 7.

problems, the running headlines and the automatically generated first page. I believe that the example is roughly self-explaining. It demonstrates a way of writing a particular form of material, where "carefully designed" macros makes a "high-level language". This should be considerably easier to use than PlainTEX, LaTEX, etc. The macro file tentamac.tex is shown in Appendix 4.

16. DVILW—DVI to PostScript filter adapted to the Laser-Writer

An Apple LaserWriter has been used as output device. This communicates in the page description language PostScript. The program DVILW is a development of an older program for the Canon LBP-10 printer. The latest modifications are by Leif Andersson and myself. The program is extensively documented in another paper, included as Appendix 5 in this report. It will most likely continue to develop, and probably we will shortly be able to let TEX handle the LaserWriter's own (beautiful!) fonts.

An earlier version of this program was used for "Adaptive Stabilization". There is an incompatibility in the treatment of the !special command, in that the older version automatically loaded prolog-files dependent on the file-type of the inserted file. This feature is replaced by a much more elaborate system for handling of the !special command.

17. The Page Description Language PostScript

By now, I have a fairly long experience of the device-independent page-description language PostScript [Adobe]. The far most common implementation is the Apple Laser-Writer.

PostScript is in many respects very nice to work with. The device independence offers great possibility for producing documents which can be printed with "identical" results on different hardware. You can get decent print-outs at your office with a "cheap" laser printer, then send the final file to a photo-typesetter.

When programming in PostScript, you are suffering from the extremely poor programming environment. The debugging aids that exist are not sufficient, and usually, just the LaserWriter barfs at you.

TEX as a Preprocessor for PostScript

The treatment of the TEX !special command implemented in DVILW offers great new possibilities. Whatever is included withing double quotes (") will be inserted as PostScript code in the resulting file. But this can be the result of macro expansion in TEX. As an example, define the macro
```
    !printHelvetica #1 #2 <!special<
```

```
"0 820 translate
/Helvetica findfont #2 scalefont setfont -1 1 scale (#1) show">>
```

(For the meaning of 0 820 translate, see the documentation of DVILW.) Thus the macro call !printHelvetica Hellow 15 will expand to PostScript code writing "Hellow" in the resident Helvetica font at 15 points, in mirror image text running from right to left.

In this way you get access to all the macro features in TeX. I have used TeX for producing PostScript pages containing nothing at all written in TeX

I definitely think it would be a very doable idea to define a simple language for describing simple figures, in particular block diagrams, which expands to PostScript code, generating figures of a quality far beyond MacDraw/MacDraft. Compare PIC and IDEAL in Unix.

18. Loose Ends

In this section I collect some information, discussion, hints and tips that does not fall naturally somewhere else.

The paper [Holmberg-Lilja-Mårtensson] contains a discussion of automatic document generation. The report [Mårtensson 1986b] describes automatic generation of TeX code from MACSYMA and CTRL-C.

The plots in "Adaptive Stabilization" were done with the differential equation program Simnon, [Åström], [Åström-Wittenmark], translated to the page description language PostScript, [Adobe], by my program Hcopy2PS. This is documented in [Mårtensson 1986c].

Under VAX/VMS version 4.x you can have a search path for a logical name. I have defined
```
tex$inputs == "use:[bengt.dirs.tex.inputs],reg:[regler.machelp.tex]"
```
in my login-file. This will make TeX look for a file without explicit directory specification in the following fashion: First the default directory is sought. Then my own favorite TeX direcory is sought, and finally the official one. The advantages are obvious.

If the LaserWriter barfs (i.e. you get "VM-error"; virtual memory overflow) when outputting complex TeX documents, a good idea is to turn off and on the power, and make sure that no Macintosh-job has been sent since last power-up. This will free several tens of kilobytes, since the Macintosh jobs permanently downloads a very large dictionary.

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Appendix 1: Thesmacro

This is the listing of `thesmacro.tex`

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% ************* Macros and definitions for thesis format **********
%
% *****************>>> Bengt Martensson <<<*************************
% ********** LastEditDate="Mon Feb 24 14:37:42 1986" *************
%
!def!v#1<<!accent"14 #1>>   %restore the original def, altered in 'altset'
!let!{=!lbrace
!let!}=!rbrace
%
%
% ******************** Preloaded fonts *********************
%
%
!font!tencalb=ambsy10 scaled 1000
!font!tenss=amss10 scaled 1000
!font!tenssi=amssi10 scaled 1000
!font!tenssbx=amssbx10 scaled 1000
!font!tensy=amsy10 scaled 1000
!font!tencaps=amcsc10 scaled 1000
!font!headerfont=amssbx10 scaled 1500
```

```
%
% Fonts used in macros in "bookmacro"
!font !chapnofont = aminch scaled 1000
!font !chapterfont = amssmc40 scaled 913
!font !lambdachapterfont = ambx10 scaled 1440
!font !lambdasectionfont = ambxsl10
!font !sectionfont = amssbx10 scaled 1200 %ambx10 scaled 1200
!font !subsectfont = amssbx10 %ambx10
!let !subsubsectfont = !sl
!let !margfont= !viiipt
!font !logfont=amti7
!font !goalfont=amssq8
!font !headfont=amti10
!let !captionfont= !viiipt
!font!fignofont=ambx8
%
!font!labelfont=amsl8
%
% Fonts in Contents-section % % % % % % % % % % % % % BM
!let!tocfont=!eightrm
!let!tocpoints=!viiipt
!let!tocchapterfont=!subsectfont
!let!tocsectionfont=!eightrm
!let!tocsubsectionfont=!eightsl
!font!toclambdachapterfont=amcsc10 scaled 833
%
!newcount !corollaryno !newcount !remarkno      % BM
!newcount !chapno  !newcount !sectionno !newcount !theoremno
!newcount !exampno !newcount !lemmano !newcount !definitionno
!newcount !resultno !newcount !figno !newcount !problemno
!newcount !equationno !newcount !abcdno
!newif !ifpagehead !global !pageheadtrue
!newif !ifabcdq
%
% Chapter begin and end
%
!chapno=-1   % If no chapters
%
!def !chapter #1<!advance !chapno by 1 % BM
  !global !pageheadfalse  !sectionno=0
  !theoremno=0 !exampno=0
  !corollaryno=0 !remarkno=0   % BM
  !lemmano=0!definitionno=0 !resultno=0
  !figno=0 !equationno=0
  !mark<>
  <!def !cr<!unskip~!ignorespaces>
    !xdef!expandedqzqz<#1>% BM
    !putincontents chapter <!the!chapno> <!expandedqzqz>
    !xdef !lefthead<<!headfont Chapter !ch !qquad #1>>>
  !vglue 15 mm !noindent
  <!chapnofont !ch>
  !vskip 10 mm
  <!baselineskip = 35 pt
    !halign<!line<!chapterfont ##!hfil>!cr#1!unskip!cr>>
  !vskip 15 mm !noindent !ignorespaces>
%
!def !lambdachapter #1<!chapno=-1 % BM
!global !pageheadfalse  !sectionno=0
!theoremno=0 !exampno=0
!corollaryno=0 !remarkno=0
!lemmano=0!definitionno=0 !resultno=0
!figno=0 !equationno=0
```

```
!putincontents lambdachapter <> <#1>
<!def !cr<!unskip~!ignorespaces>
   !xdef !lefthead<<!headfont #1>>
                    !mark<!headfont #1>>
!vglue 15 mm !noindent
<!baselineskip = 35 pt
   !halign<!line<!lambdachapterfont ##!hfil>
    !cr#1!unskip!cr>>
!vskip 15 mm !noindent !ignorespaces>
%
!def !endchapter<!vfill!supereject!dosupereject % BM
  !ifodd !pageno!else!global!pageheadfalse% unknown if this
  !vbox to 1 mm <> !vfill !eject% really works
  !fi>
!def!ch<!ifnum !chapno !< 0 !relax!else!the!chapno!fi>
!def!chdot<!ifnum !chapno !< 0 !relax!else!the!chapno.!fi>
%
!long!def!goal#1<<!narrower!narrower !baselineskip=10pt !goalfont
   !noindent GOAL:!enskip!goalfont #1!par!vskip 10 mm>>
%
% Section, subsection and subsubsection
%
!def !section #1<!advance!sectionno by 1!remarkno=0%
  !edef !ident<!chdot!the!sectionno>% BM
  !mark<!headfont!ident !quad #1>%
  !fillbreak<72pt>!vskip 21 pt plus 6 pt minus 6 pt%
  !xdef!expandzqzq<!chdot!the!sectionno>% BM
  !putincontents section <!expandzqzq> <#1>% BM
  !sectionheading <!ident!quad#1>>
%
!def !lambdasection #1<!edef !ident<>%
                      %!mark<!headfont#1>
!fillbreak<72pt>!vskip 21 pt plus 6 pt minus 6 pt%
!putincontents lambdasection <> <#1>% BM
!leftline<<!lambdasectionfont#1>>%
!nobreak!vskip 12 pt !noindent!ignorespaces>
%
%
!def!sectionheading #1<!leftline<<!sectionfont#1>>%
 !nobreak!vskip 12 pt!noindent!ignorespaces>
%
!def!subsection #1<!fillbreak<60pt>!bigskip%
    !leftline<!subsectfont #1>!nobreak%
    !putincontents subsection <> <#1>% BM
    !vskip 6pt !noindent !ignorespaces>
!def!subsubsection #1<!medbreak!leftline<!subsubsectfont#1>% BM
       !putincontents subsubsection <> <#1>% BM
       !vskip 6pt!noindent!ignorespaces>% BM
%
!def!beginfirstchapter<!putincontents <beginfirstchapter> <> <>>
!def!endlastchapter<!putincontents <endlastchapter> <> <>>
%
% Figure captions
%
!def!caption#1<!global !advance !figno by 1
!captionfont
!edef !ident<!chdot!the!figno>
!putincontents figure <!chdot!the!figno> <> % maybe change
!global !let !butlastfig = !lastfig
!global !let !lastfig = !ident
!setbox0=!hbox<<!bf Figure !ident> !enspace #1>
!dimen0=!hsize !advance !dimen0 by -2!parindent
```

```
!ifdim !wd0 !> !dimen0 !narrower
!noindent <!bf Figure !ident.>!enspace #1 !par
!else !centerline<<!bf Figure !ident.>!enspace #1> !fi
!noindent!ignorespaces>
%
!def !nextfigure<!count255=!figno !advance !count255 by 1
  !chdot!the!count255> % BM
%
%  % Table of Contents
% How the different entries should be treated % % %
!newdimen !TOCnumberwidth !TOCnumberwidth=5mm
!newdimen !TOCindent !TOCindent=3mm
!def!begincontents<!begingroup!ignorespaces!tocpoints>
!def!endcontents<!endgroup>
!def!TOCchapter #1 #2 #3<!bigbreak
  !vbox<!hbox to
 !hsize<!phantom<#3>!hfill%
 <!tocchapterfont#1.!enspace#2>%
 !hfill!phantom<#3>>
 !smallskip>>
!def!TOClambdachapter #1 #2 #3<!hbox to !hsize<!toclambdachapterfont#2%
!tocfont!dotfill#3>>
!def!TOCsection #1 #2 #3<!vbox<!hbox to
!hsize<!hbox to !TOCnumberwidth<!tocfont#1%
 !hfill>%
!tocsectionfont#2!tocfont!dotfill#3>>>
%
!def!TOCsubsection #1 #2 #3<!vbox<!hbox to !hsize<!hskip!TOCnumberwidth%
   !hskip!TOCindent%
   !tocsubsectionfont#2%
   !tocfont!dotfill#3>>>
%
!def!TOCsubsubsection #1 #2 #3<!relax>% Don't care for subsubsections
!def!TOClambdasection #1 #2 #3<!relax>
!def!TOCfigure #1 #2 #3<!relax> % Don't care for figures
!def!TOCbeginfirstchapter #1 #2 #3<!bigbreak>
!def!TOCendlastchapter #1 #2 #3<!bigbreak>
% ********************************************************
%
% Itemization
%
!newdimen !itemmarg !itemmarg=!maxdimen
!let !itemskip=!smallskip
!def!itemq#1<!ifdim!itemmarg=!maxdimen !itemmarg=!parindent!fi
      !itemskip!hangindent=!itemmarg!noindent
      !hbox to !itemmarg<#1>!ignorespaces>
!def!leftitem #1<!itemq<#1!hfil>>
!def!rightitem #1<!itemq<!hfil #1!enspace>>
!let !item = !leftitem
%
% Displayed equations
%
!newif !ifeqno
%
%% Equation numbering
%
!def!autoeqno<!let !eqqno=!eqno !let !eqno=!eqqqno>
!def !eqqqno<!global !advance !equationno by 1
    !global!edef !ident<!ifnum !chapno = -1 (!the!equationno)
!else (!chdot!the!equationno)!fi>
!global !let !butlasteq=!lasteq
!global!let !lasteq=!ident !eqqno!ident>
```

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```
% Unexpandedwrite, p. 337
%  % % % % % % % %
!long!def!unexpandedwrite#1#2<!def!finwrite<!write#1>%
  <!aftergroup!finwrite!aftergroup<!sanitize#2!endsanity>>>
!def!sanitize<!futurelet!next!sanswitch>
!def!sanswitch<!ifx!next!endsanity
!else!ifx!next!folio!aftergroup!foliospace!let!next=!eat % BM
               !else!ifcat!noexpand!next!space!aftergroup!space!let!next=!eat % BM
!else!ifcat!noexpand!next!bgroup!aftergroup<!let!next=!eat
               !else!ifcat!noexpand!next!egroup!aftergroup>!let!next=!eat
!else!let!next=!copytoken!fi!fi!fi!fi!fi!next> % BM
!def!eat<!afterassignment!sanitize !let!next= >
!long!def!copytoken#1<!ifcat!noexpand#1!relax!aftergroup!noexpand
        !else!ifcat!noexpand#1!noexpand~!aftergroup!noexpand!fi!fi
        !aftergroup#1!sanitize>
!def!endsanity!endsanity<>
!def!foliospace<!the!pageno!space>% present indexprogram cannot handle
  % roman numerals
% !def!foliospace<!folio!space>
%
% Index, Notes and References
%
!newwrite !logfile
!newif!iflogopen !logopenfalse
% !newwrite !indexfile
% !newif!ifindexopen !indexopenfalse
!newinsert!margin
!newskip !savelastskip
!def !marginstyle<!margfont !vrule height 5pt depth 2pt width 0pt>
!dimen!margin=!maxdimen !count!margin=0 !skip!margin=0pt
!def!index#1<!iflogopen !else !logopentrue
       !immediate !openout !logfile=!jobname.log !fi
       !insert!margin<!hbox<!marginstyle #1>>!ignorespaces
       !unexpandedwrite!logfile<I !folio : #1>!ignorespaces>
!def!note#1<!iflogopen !else !logopentrue
       !immediate !openout !logfile=!jobname.log !fi
       !insert!margin<!hbox<!marginstyle !it #1>>!ignorespaces
       !write!logfile<L !the!pageno!space!space #1>!ignorespaces>
!def!reference#1<!iflogopen !else !logopentrue
   !immediate !openout !logfile=!jobname.log !fi
   !write!logfile<R !the!pageno!space!space #1>[#1]>
%
%  Contents % % % % %
!newwrite!contentsfile
!newif!ifcontentsfileopen !contentsfileopenfalse
!newcount!talky!talky=0 % If nonzero echo to screen
!def!settalky<!talky=1>
!def!putincontents #1 #2 #3<!ifcontentsfileopen!else!contentsfileopentrue%
       !immediate!openout%
       !contentsfile=!jobname.toc !fi%
       <!let!theinfolio=0%
         !edef!writeit<!write!contentsfile<!string!TOC#1
   !<#2!>
   !<#3!>
   !<!folio!>>>%
         !writeit%
       >% ref p. 332 TeX-book, might not work if
       % pageno less than 0
       !ifnum!talky=0!else!message<#1 #2 #3>!fi>
%
% STUFF FOR BIBLIOGRAPHY ************************************************
!catcode'@=11
```

```
!def!eat@AmS#1<>
!def!refto#1<!in@AmS,<#1>!if T!cresult@AmS!refto@AmS#1!end@AmS!else      % NOTE 30
   [<!bf#1>]!fi>
!def!refto@AmS#1,#2!end@AmS<[<!bf#1>,#2]>
%
!def!Refs<!bigbreak!hbox to !hsize<!hfil!tenpoint
   !smc !Referenceword@AmS!hfil>!penalty 10000
      !bigskip!eightpoint!sfcode'.=1000 >                                 % NOTE 31
!def !references<!begingroup
   !parindent=0pt
   !def !and<<!rm and >>!def !ed<<!rm (Ed.) >>!def !eds<<!rm (Eds.) >>
   !parskip=3pt !def !text<!smallbreak !text@@true!ignorespaces>>
!def !endreferences<!endgroup>
%
!newbox!nobox@AmS          !newbox!keybox@AmS          !newbox!bybox@AmS   % NOTE 32
!newbox!bysamebox@AmS      !newbox!paperbox@AmS        !newbox!paperinfobox@AmS
!newbox!jourbox@AmS        !newbox!volbox@AmS          !newbox!issuebox@AmS
!newbox!yrbox@AmS          !newbox!pagesbox@AmS        !newbox!bookbox@AmS
!newbox!inrefbox@AmS
!newbox!bookinfobox@AmS    !newbox!publbox@AmS         !newbox!publaddrbox@AmS
!newbox!finalinfobox@AmS   !newbox!reportbox@AmS       !newbox!reportinfobox@AmS
 !newif!iftext@@
%
!def!refset@AmS#1<!expandafter!gdef!csname is!expandafter!eat@AmS        % NOTE 33
   !string#1@AmS!endcsname<F>!expandafter
   !setbox!csname !expandafter!eat@AmS!string#1box@AmS!endcsname=!null>
%
!def!ref@AmS<%
   !refset@AmS!no !refset@AmS!key !refset@AmS!by                  % NOTE 34
   !gdef!isbysame@AmS<F>%                                             % NOTE 35.1
   !refset@AmS!paper  !refset@AmS!paperinfo
   !refset@AmS!report !refset@AmS!reportinfo
   !refset@AmS!jour !refset@AmS!vol
   !refset@AmS!issue !refset@AmS!yr
   !gdef!istoappear@AmS<F>%                                           % NOTE 35.2
   !refset@AmS!pages
   !gdef!ispage@AmS<F>%                                               % NOTE 35.3
   !refset@AmS!book !refset@AmS!inref
   !gdef!isinbook@AmS<F>%                                             % NOTE 35.4
   !refset@AmS!bookinfo !refset@AmS!publ
   !refset@AmS!publaddr !refset@AmS!finalinfo
   !bgroup !ignorespaces>                           % NOTE 36

!def!bref<%
   !def!refi@AmS<T>%     % NOTE 37
   !def!refl@AmS<F>!def!!<!egroup!endref@AmS!gdef!refi@AmS<F>!ref@AmS>
   !ref@AmS!by>
%
!def!refdef@AmS#1#2<!def#1<!egroup!expandafter                        % NOTE 38
   !gdef!csname is!expandafter!eat@AmS
   !string#1@AmS!endcsname<T>!expandafter!setbox
   !csname !expandafter!eat@AmS!string#1box@AmS!endcsname=%
   !hbox!bgroup#2!ignorespaces>!ignorespaces>

!refdef@AmS!no<> !refdef@AmS!key<> !refdef@AmS!by<!csc>
!refdef@AmS!inref<!csc>
!def!bysame<!egroup!gdef!isbysame@AmS<T>!bgroup>                      % NOTE 39.1
!refdef@AmS!paper<> !refdef@AmS!paperinfo<>
!refdef@AmS!report<> !refdef@AmS!reportinfo<>
!refdef@AmS!jour!sl !refdef@AmS!vol!bf
!refdef@AmS!issue<> !refdef@AmS!yr<>
!def!toappear<!egroup!gdef!istoappear@AmS<T>!bgroup>                  % NOTE 39.2
```

```
!refdef@AmS!pages<>
!def!page<!egroup!gdef!ispage@AmS<T>!setbox
            !pagesbox@AmS=!hbox!bgroup>                          % NOTE 39.3
!refdef@AmS!book!sl
!def!inbook<!egroup!gdef!isinbook@AmS<T>!setbox
                        !bookbox@AmS=!hbox!bgroup>               % NOTE 39.4
!refdef@AmS!bookinfo<> !refdef@AmS!publ<>
!refdef@AmS!publaddr<>
!refdef@AmS!finalinfo<>


!def!setpunct@AmS<!def!prepunct@AmS<, >>                          % NOTE 40
!def!ppunbox@AmS#1<!prepunct@AmS!unhbox#1!unskip>                 % NOTE 41
!def!nopunct@AmS<!def!prepunct@AmS<>>

!def!endref@AmS<!nopunct@AmS%                              % NOTE 42
!if T!refi@AmS                                            % NOTE 43.1
% !if F!isno@AmS!hbox to 0pt<>!else   %10pt originally /LA % NOTE 43.2
%    !hbox to 20pt<!hss!unhbox!nobox@AmS!unskip. >!fi      % NOTE 43.3
  !iftext@@ !text@@false !smallbreak !fi
  !par !hangindent=10pt !hangafter=1 !noindent % 20pt originally /BM
% !hbox to 10pt<!hfil> removed by BM
  !ignorespaces
  !if T!iskey@AmS !unhbox!keybox@AmS!unskip! !fi                  % NOTE 43.4
  !if T!isby@AmS !unhcopy!bybox@AmS!unskip!setpunct@AmS     % NOTE 43.5
        !setbox!bysamebox@AmS=!hbox<!unhcopy!bybox@AmS!unskip>!fi % NOTE 43.6
  !if T!isbysame@AmS                                        % NOTE 43.7
   !hbox to 3em<!vbox to 10pt<!vskip 8pt!hbox to 3em<!leaders!hrule!hfill>
                  !vfill>>!setpunct@AmS!fi % BM
 !fi                                                        % NOTE 43.8
  !if T!isyr@AmS!def!prepunct@AmS<: >~(!unhbox!yrbox@AmS!unskip)!fi
  !if T!ispaper@AmS!prepunct@AmS ''!unhbox!paperbox@AmS
        !unskip'', !nopunct@AmS!fi          % NOTE 44
  !if T!ispaperinfo@AmS!ppunbox@AmS!paperinfobox@AmS!setpunct@AmS!fi % NOTE 45
  !if T!isreport@AmS !prepunct@AmS ''!unhbox!reportbox@AmS
        !unskip'', !nopunct@AmS!fi
  !if T!isreportinfo@AmS !prepunct@AmS !unhbox!reportinfobox@AmS
    !setpunct@AmS!fi
  !if T!isinref@AmS !prepunct@AmS % This stuff is moved by BM
        in !unhbox!inrefbox@AmS!unskip !def!prepunct@AmS<: >!fi
  !if T!isbook@AmS !prepunct@AmS      % 46 and 47 permutated by BM% NOTE 47
                    !unhbox!bookbox@AmS!unskip!setpunct@AmS!fi
  !if T!isjour@AmS!ppunbox@AmS!jourbox@AmS!setpunct@AmS         % NOTE 46
     !if T!isvol@AmS ! !unhbox!volbox@AmS!unskip!setpunct@AmS!fi  % NOTE 46.1
     !if T!isissue@AmS ! !unhbox!issuebox@AmS!unskip!setpunct@AmS!fi% NOTE 46.2
%    !if T!isyr@AmS ! (!unhbox!yrbox@AmS!unskip)!setpunct@AmS!fi  % NOTE 46.3
     !if T!istoappear@AmS ! (to appear)!setpunct@AmS!fi          % NOTE 46.4
     !if T!ispages@AmS !ppunbox@AmS!pagesbox@AmS!setpunct@AmS
           !gdef!ispages@AmS<F>!fi   % BM                       NOTE 46.5
     !if T!ispage@AmS                                           % NOTE 46.6
           !prepunct@AmS p.! !unhbox!pagesbox@AmS!unskip!setpunct@AmS!fi
    !fi                                                         % NOTE 46.7
% Stuff moved from here by BM
  !if T!isinbook@AmS !prepunct@AmS                              % NOTE 48
    !unskip! in !unhbox!bookbox@AmS!unskip!setpunct@AmS
      !gdef!isbook@AmS<T>!fi
  !if T!isbookinfo@AmS !ppunbox@AmS!bookinfobox@AmS!setpunct@AmS!fi % NOTE 49
  !if T!ispubl@AmS !ppunbox@AmS!publbox@AmS!setpunct@AmS!fi     % NOTE 50
  !if T!ispubladdr@AmS !ppunbox@AmS!publaddrbox@AmS!setpunct@AmS!fi % NOTE 51
 !if T!isbook@AmS                                               % NOTE 52
% !if T!isyr@AmS !prepunct@AmS !unhbox!yrbox@AmS!unskip         % NOTE 52.1
%              !setpunct@AmS!fi
```

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```
    !if T!istoappear@AmS ! (to appear)!setpunct@AmS!fi        % NOTE 52.2
    !if T!ispages@AmS                                         % NOTE 52.3
      !prepunct@AmS !unhbox!pagesbox@AmS!unskip!setpunct@AmS!fi
    !if T!ispage@AmS                                          % NOTE 52.4
      !prepunct@AmS p.! !unhbox!pagesbox@AmS!unskip!setpunct@AmS!fi
  !fi
    !if T!isfinalinfo@AmS !period!unhbox!finalinfobox@AmS!else  % NOTE 53
      !if T!refl@AmS .!else ; !fi!fi>

!def!endref<!egroup!gdef!refl@AmS<T>!endref@AmS!par>
!catcode'@=12
% ************************************************************************
%
%%%%%%%%%%%%%%%%%% Cross references %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%
!newwrite !xreffile % Might not work if pageno < 0
!newif!ifxrefopen !xrefopenfalse
!catcode '@=11
!def !w@log #1<!immediate !write16<#1>>
%
!def !label#1<!ifxrefopen!else<!global!xrefopentrue>%
        !immediate!openout!xreffile=!jobname.xre!relax!fi%
        <!let!theinfolio=0%
 !edef!writeit<!write!xreffile<!string!filelabel !<#1!>
!<!ident!>
!<!folio!>%
        >%
        >%
        !writeit%
        >%
        !insert!margin<!hbox<!marginstyle!labelfont #1 = !ident>>%
        !ignorespaces>
%
!def !filelabel#1#2#3<!if@undefined <r@#1>
        <> <!w@log <Label "#1" multiply defined.>>
        !ignorespaces
        !label@def<r@#1> <#2> <#3>
        !ignorespaces
     >
%
!def !label@def #1 #2 #3<!expandafter!xdef !csname #1@xxx!endcsname<#2>
                        !expandafter!xdef !csname #1@page!endcsname<#3>>
%
!def !xref #1<!if@undefined <r@#1><!w@log
    <Label "#1" undefined.>
    <!bf ???>><!label@use <r@#1>>>
!def !pageref #1<!if@undefined <r@#1><!w@log
      <Label "#1" undefined.>
      <!bf ???>><!pagelabel@use <r@#1>>>
!def !label@use #1<!csname #1@xxx!endcsname>
!def !pagelabel@use #1<!csname #1@page!endcsname>
!def !if@undefined #1#2#3<!expandafter !ifx !csname
   #1@xxx!endcsname!relax #2!else#3!fi>
!catcode '@=12
%
% % % % % % % % % % % Output macros % % % % % % % % % % % % % % % %
%
% Make a new 'folio' which does not print anything if 'pageno' = 0
% Also uses 'theinfolio' instead of 'number' to possibly suppress evaluation
% in the 'edefs' for writing contents and references
%
!let!theinfolio=!the
```

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```
!let!romannumeralinfolio=!romannumeral
!def!folio<!ifnum!pageno!>0 !theinfolio!pageno
          !else!romannumeralinfolio-!pageno!fi>
%
!newdimen!pagewidth !newdimen!pageheight
!newdimen!ruleht !ruleht=0.4pt  % BM
!def !date<!number!year-!number!month-!number!day:!enspace!number!time>
!def!onepageout#1<!shipout!vbox<% BM
    !offinterlineskip
    !vbox to 0 pt <%
      !ifpagehead
        !vskip -30pt
        !ifodd !pageno !rightheadline
        !else !leftheadline
        !fi
      !else !global!footline=<!hfil!tenrm!folio!hfil!llap<!date>>
      !fi
      !vfill>
    !vbox to !pageheight<%  BM
      !ifvoid !margin
      !else
        !rlap<!kern!pagewidth !kern 2mm
          !vbox to 0pt<!hsize=20 true mm
            !kern 3mm !box!margin !vss>>
      !fi
      !ifpagehead
        !ifvoid!topins!else!unvbox!topins!fi
      !fi
      #1 % BM
      !ifpagehead !else
        !ifvoid !topins!else!unvbox!topins!fi
      !fi
      !ifvoid!footins!else
        !vskip !skip !footins !kern -3pt
        !hrule height !ruleht width !hsize !kern -!ruleht !kern 3pt
        !unvbox!footins
      !fi
      !vbox to 0 pt<!vskip 12 pt !hbox to !pagewidth<!the !footline>!vss>
      !boxmaxdepth=!maxdepth>>
      !global!pageheadtrue !global!footline=<!tenrm!hfill!date>
    !advancepageno>
!def !leftheadline<!hbox to !pagewidth<!tenrm!folio !hfill !lefthead>>
!def !rightheadline<!hbox to !pagewidth<!topmark !hfill!tenrm !folio>>
!global!footline=<!tenrm!hfill!date>
!def !finalversion<!let !note=!dummymacro%
    !let !index=!dummymacro%
    !let !label=!dummymacro%
    !let !intolog=!dummymacro%
    !let !date=!relax>
!def !dummymacro#1<!relax!ignorespaces>
!topskip=10pt
%
!output<!onepageout<!unvbox255>> % BM
%
% Initial values to lefthead and righthead
%
!def !lefthead<>
!def !righthead<>
%
%%%%%%%%%%%%%%% Index %%%%%%%%%%%%%%%%%%%%%%%%
%
!newdimen!colwidth !newdimen!bigcolheight
```

```
!colwidth=55mm  !bigcolheight=371mm
!newbox!partialpage
!newdimen!savesize
!def!begindoublecolumns<!begingroup
                        !global!savesize=!vsize
                        !output=<!global!setbox!partialpage=%
                                !vbox<!unvbox255!bigskip>>!eject
                        !output=<!doublecolumnout> !hsize=!colwidth
                        !vsize=!bigcolheight
                        !advance!vsize by -2!ht!partialpage>
!def!enddoublecolumns<!output=<!balancecolumns>!eject
                      !global!output=<!onepageout<!unvbox255>>
                      !global!vsize=!savesize
                      !endgroup !pagegoal=!vsize>
%
!def!doublecolumnout<!splittopskip=!topskip !splitmaxdepth=!maxdepth
                     !dimen0=!savesize !advance!dimen0 by-!ht!partialpage
                     !setbox0=!vsplit255 to!dimen0
                     !setbox2=!vsplit255 to!dimen0
                     !onepageout!pagesofar
                     !global!vsize=!bigcolheight
                     !unvbox255 !penalty!outputpenalty>
!def!pagesofar<!unvbox!partialpage
               !wd0=!hsize !wd2=!hsize !hbox to!pagewidth<!box0!hfil!box2>>
!def!balancecolumns<!setbox0=!vbox<!unvbox255> !dimen0=!ht0
                    !advance!dimen0 by!topskip
                    !advance!dimen0 by-!baselineskip
                    !divide!dimen0 by2 !splittopskip=!topskip
                    <!vbadness=10000 !loop !global!setbox3=!copy0
                      !global!setbox1=!vsplit3 to!dimen0
                      !ifdim!ht3!>!dimen0
                      !global!advance!dimen0 by1pt !repeat>
                    !setbox0=!vbox to!dimen0<!unvbox1>
                    !setbox2=!vbox to!dimen0<!unvbox3>
                    !pagesofar>
%
!def!beginindex<!begingroup
 !obeylines
 !begindoublecolumns
 !leftskip=1em
 !parindent=-1em
 !def!streck<!hbox
        <!vbox
<!vfill !hrule width 0.4pt height 4.5pt
  !vskip 0.7pt>>>
 !viiipt
 !raggedright
 !tolerance=5000!hbadness=5000!parfillskip= 0pt plus 3em
 !def!sub<---!ignorespaces>
 !def!see<<!sl see!/>~!ignorespaces>
 !def!also<!hfil!penalty50%
     !hfilneg<!sl see~also!/>~!ignorespaces>
 !hyphenpenalty=10000 !exhyphenpenalty=10000
 !def!newletter##1<!medbreak!leftline<!hskip 15mm<!bf ##1>>
     !hangindent 2em>
 !par>
%
!def!endindex<!enddoublecolumns!endgroup>
%
% Redefinitons of macros from Plain
%
!catcode'!@=11
```

```
!abovedisplayskip=12pt plus 3pt minus 6pt
!belowdisplayskip=12pt plus 3pt minus 6pt
!def !@ins<!begingroup!setbox0=!vbox!bgroup>
!def !pmatrix#1<!left!lgroup !matrix<#1> !right!rgroup>
!newdimen !displayopen !displayopen=1 !jot
!newdimen !matrixopen !matrixopen=1 !jot
!def !matrixbaselines<!normalbaselines
        !advance !baselineskip !matrixopen
        !advance !lineskiplimit !matrixopen
        !advance !lineskip !matrixopen>
!def!matrix#1<!,!vcenter<!matrixbaselines!m@th
  !ialign<!hfil$##$!hfil&&!quad!hfil$##$!hfil!crcr
   !mathstrut!crcr!noalign<!kern-!baselineskip>
   #1!crcr!mathstrut!crcr%
   !noalign<!kern-!baselineskip>>>!,>
!def!eqalign#1<!,!vcenter<!displ@y
    !ialign<!strut!hfil$!displaystyle<##>$&$%
     !displaystyle<<>##>$!hfil
     !crcr#1!crcr>>!,>
!def!displaylines#1<!vcenter<!displ@y
      !ialign<!hbox to
       !displaywidth<$!hfil!displaystyle##!hfil$>!crcr
       #1!crcr>>>
!def!displ@y<!global!dt@ptrue!openup!displayopen!m@th
      !everycr<!noalign<!ifdt@p !global!dt@pfalse
 !vskip-!lineskiplimit !vskip!normallineskiplimit
 !else !penalty!interdisplaylinepenalty !fi>>>
!def !fillbreak#1<!par !dimen0=!pagetotal !advance !dimen0 by #1
    !ifdim !dimen0 !> !pagegoal !vskip 0pt plus #1!penalty-100
    !vskip 0pt plus -#1!fi>
!catcode'!@=12
%
% Set the format
%
!hsize=120 mm !vsize =185 mm
!pageheight=!vsize !pagewidth=!hsize % BM
!nonfrenchspacing
%
!mag = 1200
!def!canon<%!font!sectionfont=amssbx10 scaled 1141
    !global!def!special ##1<>>
%
% ************ Enhancements in the spirit of 'Bookmacro' ***********
%
!def!enumeratetheorem<!global !advance !theoremno by 1
       !xdef !ident<!chdot!the!theoremno>
       !ident>
!def!enumerateremark<!global !advance !remarkno by 1
       !xdef !ident<!the!remarkno>
       !ident>
!let!enumeratelemma=!enumeratetheorem
!let!enumeratedefinition=!enumeratetheorem
!let!enumerateexample=!enumeratetheorem
!let!enumeratecorollary=!enumeratetheorem
!let!enumerateproposition=!enumeratetheorem
%
!def !theoremnumber<!the!theoremno>
!def !lemmanumber<!the!theoremno>
!def !definitionnumber<!the!theoremno>
!def !examplenumber<!the!theoremno>
!def !corollarynumber<!the!theoremno>
!def !propositionnumber<!the!theoremno>
```

```
!def !remarknumber<!the!remarkno>
%
!def !rectangle #1 #2<!hbox<!vrule !vbox to #2
     <!hrule!hbox to #1<!hfil>!vfil!hrule>!vrule>>
!edef !endgadget #1<<!unskip!nobreak!hfil!penalty50!hskip1em!hbox<>!nobreak
     !hfil#1!parfillskip=0pt!finalhyphendemerits=0!par>>
%
!def!endremarksymbol<!rectangle <3pt> <4pt>>
!def!endremark<!endgadget<!endremarksymbol>!smallbreak!noindent!ignorespaces>
!let!enddefinition=!endremark
!let!endassumption=!endremark
!let!endnotation=!enddefinition
!let!endexample=!endremark
!def!endproclaim<!par!noindent!ignorespaces>
!let!AmSqed=!qed
!def!qedsymbol<!vrule height4pt width4pt depth0pt>
!def!qed<!endgadget<!qedsymbol>!smallbreak!noindent!ignorespaces>
!def!poemmode<!parskip=0mm!obeylines>
%
!catcode '<=12 !catcode '{=1 !catcode '}=2
!long!def!proclaim #1. #2!endproclaim{!medbreak
  !noindent{!csc#1.!enspace>
                       {!sl#2>!endproclaim%
                       !ifdim!lastskip<!medskipamount !removelastskip%
                               !penalty55!medskip!fi>
!catcode '<=1 !catcode '{=12!catcode '}=12
%
!def!specialsection #1<!medbreak
!noindent<!tenssi #1 !enspace>>
%
!def!definition<!specialsection<Definition !enumeratedefinition.>>
!def!remark<!specialsection<Remark !enumerateremark.>>
!def!example<!specialsection<Example !enumerateexample.>>
%
!def!proof<!specialsection<Proof.>>
%
!def!assumption<!specialsection<Assumption.>>
!def!notation<!specialsection<Notation.>>
%
!let!subsect=!subsection              % just another name, for compatibility
!let!subsubsect=!subsubsection        % with Bookmacro
%
%%%%%%%%% Change these defs to 'relax' for multi chapter processing %%%%%
!let!goodbye=!bye
!def!inputxrefs<!input !jobname.xre>
% *************** On the format *******************************
%
!itemmarg=7.5mm
%
% ************* Flags in AmSTeX *****************************
!TagsOnRight
!TagsAsText
!CenteredTagsOnBrokens
!NoLimitsOnInts
!LimitsOnSums
% ************* Blackbord-bold fonts ***********************
%
!def!streck<!hbox <!vbox <!vfill !hrule width 0.5pt height 6pt !vskip 0.7pt>>>
!def!complexC<!hbox<!hskip 1.5pt !streck !hskip -3.2pt <!rm C>>>
!def!rationalQ<!hbox< !streck !hskip -3pt <!rm Q>>>
!def!negativethinspace<!mskip-!thinmuskip>
!def!realR<!hbox<$!rm I !negativethinspace R $>>
```

```
% !def!complexC<!hbox<$!rm I !negativethinspace !negativethinspace
%       !negativethinspace C $>>
% !def!rationalQ<!hbox<$!rm I !negativethinspace !negativethinspace
%         !negativethinspace Q $>>
!def!integerZ<!hbox<$!rm Z !negativethinspace  !negativethinspace Z $>>
!def!bbbT<!hbox<$!rm T !negativethinspace
 !negativethinspace !negativethinspace T $>>
!def!naturalN<!hbox<$!rm I !negativethinspace N $>>
!def!bbbM<!hbox<$!rm I !negativethinspace M $>>
!def!bbbI<!hbox<$!rm I !negativethinspace I $>>
%
% ************** Math function names to be typeset in roman **********
%
!def!diag<!operatorname<diag>>
!def!codomain<!operatornamewithlimits<Codomain>>
!def!sp<!operatornamewithlimits<sp>>
!def!span<!operatornamewithlimits<span>>
!def!Grass<!operatorname<Grass>>
!def!Re<!operatorname<Re>>
!def!re<!operatorname<Re>>
!def!Im<!operatorname<Im>>
!def!im<!operatornamewithlimits<im>>
!def!rank<!operatornamewithlimits<rank>>
!def!card<!operatornamewithlimits<card>>
!def!mod<!operatorname<mod>>
!def!log<!operatornamewithlimits<log>>
!def!block<!operatorname<block>>
!def!intfunction<!operatorname<int>>
!def!sign<!operatorname<sign>>
!let!|=!Vert
%
% ******************** Macros for composite mathematical objects ****
%
!def!GLn<!hbox<$<!cal GL>(n)$>>
!def!GLnk<!hbox<$<!cal GL>(n,k)$>>
!def!GLnQ<!hbox<$<!cal GL>(n,!rationalQ)$>>
!def!GLnR<!hbox<$<!cal GL>(n,!realR)$>>
!def!SOn<!hbox<$<!cal SO>(n)$>>
!def!SOnk<!hbox<$<!cal SO>(n,k)$>>
!def!SOtwo<!hbox<$<!cal SO>(2)$>>
!def!SOthree<!hbox<$<!cal SO>(3)$>>
!def!SOthreeZ<!hbox<$<!cal SO>(3,!integerZ)$>>
!def!On<!hbox<$<!cal O>(n)$>>
!def!Onk<!hbox<$<!cal O>(n,k)$>>
!def!Om<!hbox<$<!cal O>(m)$>>
!def!OnZ<!hbox<$<!cal O>(n,!integerZ)$>>
!def!VstarkerC<!hbox<!tenssbx V>^* _<!ker C>> %want German or Script
!def!RstarkerC<!hbox<!tenssbx R>^* _<!ker C>>
!def!distributionD<!hbox<$<!cal D>$>>
!def!distributionE<!hbox<$<!cal E>$>>
!def!plantset<!hbox<$!cal G$>>
!def!controllerset<!hbox<$!cal K$>>
!def!continuousC<!hbox<$<!cal C>$>>
!def!Comega<<!cal C>^!omega>
!def!Ck<<!cal C>^k>
!def!Cinfinity<<!cal C>^!infty>
!def!sigmamax<!overline !sigma>
!def!sigmamin<!underline !sigma>
!let!asymptoticexpansion=!asymp
%
%
% Macros for heart, spade, etc.
```

```
%
!def!heart<!hbox<$!heartsuit$>>
!def!spades<!hbox<$!spadesuit$>>
!def!spade<!hbox<$!spadesuit$>>
!def!club<!hbox<$!clubsuit$>>
!def!diamond<!hbox<$!diamondsuit$>>
%
!def!Atilde<!tilde A>     %to be adjusted later
!def!Abar<!bar A>     %to be adjusted later
%
!def!factorial<!char"21>
%
!def!martensson<M!sveaa rtensson>
!def!astrom<!sveAA str!sveoe m>
!def!hormander<H!sveoe rmander>
!def!hagglund<H!sveae gglund>
!def!arzen<!sveAA rz!' en>
%
!def!postscript<<!csc PostScript>>%
% ************************ Math macros **************************
%
!def!mapright#1<!quad!smash<!mathop<!longrightarrow>!limits^<#1>>!quad>
!def!maprightto#1<!quad!smash<!mathop<!longmapsto>!limits^<#1>>!quad>
!def!Matrix#1<!left!lgroup!matrix<#1>!right!rgroup>
!def!operatorrestriction#1 #2<!left. #1 !right|_<#2>>
%
!def!equationtag#1<!index<(#1)>!tag<#1>>
!def!specialequationnoindex#1#2<
 !vbox<!vskip-#2                           %get up!
!hbox to 119mm<!hfill (#1)>         %print right justified
!dimen0=#2!advance!dimen0 by -8mm  %how much to go down
!vskip !dimen0                      %get down
        >
 !index<(#1)>
 !noindent
       >
!def!specialequationno#1#2<>
%!def!specialequationnoindex#1#2<!index<(#1)>!specialequationno<#1><#2>>
%
!def!widedot<!, . !,>
% ************* Hyphenation
%
!hyphenation<man-u-script man-u-scripts>
!hyphenation<au-to-no-mous an-a-lyze ap-pen-dix geo-met-ric Lip-schitz>
!hyphenation<mod-el-ing non-euclid-ean non-smooth pa-ram-e-trized>
!hyphenation<semi-def-in-ite set-up sto-chas-tic sum-ma-ble>
```

Appendix 2: Slides

```
% % % % % % % Slides % % % % % % % %
%
% LastEditDate="Fri Aug  1 12:43:48 1986"
%
%
%
!def!huge#1 <<!hugefont #1>>
!def!Bigstyle#1 <<!Bigfont #1>>
!def!bigstyle#1 <<!bigfont #1>>
```

```
%
!def!hugeleftline#1 <!leftline <!huge<#1> >>
!def!hugecenterline#1 <!centerline <!huge<#1> >>
!def!Bigleftline#1 <!leftline <!Bigstyle<#1> >>
!def!Bigcenterline#1 <!centerline <!Bigstyle<#1> >>
!def!bigleftline#1 <!leftline <!bigstyle<#1> >>
!def!bigcenterline#1 <!centerline <!bigstyle<#1> >>
%
!font!fivei=ami7 scaled 695
!font!eightrm=amr10 scaled 833
!font!eightbf=ambx10 scaled 833
!font!eightit=amti10 scaled 833
!font!eightsl=amsl10 scaled 833
!font!eighttt=amtt10 scaled 833
!xpt
!nopagenumbers
% !input verbatim

% !def !bull <!item <$!bullet$>>
!def!list<!nobreak!smallskip!bgroup!obeylines>
!def!elist<!egroup!smallbreak!noindent!ignorespaces>
!newdimen !itemmarg !itemmarg=!maxdimen
!let !itemskip=!smallskip
!def!itemq#1<!ifdim!itemmarg=!maxdimen !itemmarg=!parindent!fi
            !itemskip!hangindent=!itemmarg!noindent
            !hbox to !itemmarg<#1>!ignorespaces>
!def!leftitem #1<!itemq<#1!hfil>>
!def!rightitem #1<!itemq<!hfil #1!enspace>>
%
%
!newwrite !logfile
!newif!iflogopen !logopenfalse
%
!def!creationdate<!number!year-!number!month-!number!day:!enspace!number!time>
!headline=<!headlinefont!folio!hfill!creationdate>
!def!finalversion<!global!headline=<!hfill>>
%
!def!beginslide #1<!iflogopen !else !logopentrue%
                   !immediate !openout !logfile=!jobname.log !fi%
                   !write!logfile<Page !folio : #1>!ignorespaces%
                   !leavevmode!vfill!vbox!bgroup%
            >
!def!endslide<!egroup!vfill!vfill!eject>
%
<!obeylines                        %
!gdef!begintitleslide<!beginslide <The Title Slide>%
                   !obeylines%
!outer!def!begintitle<!vglue10truemm%
                   !begingroup%
                   !hugefont%
                   !parskip=!medskipamount%
                   !def!par<!hss!egroup!endgraf!hbox to !hsize!bgroup!hss>%
                   !obeylines%
                   !hbox to !hsize!bgroup!hss%
            >                      %
!outer!def!endtitle<!hss!egroup!endgraf!endgroup!par>%
!outer!def!author ##1<!vskip5truemm!centerline<<!Bigfont ##1>>>%
!def!beginaddress<!begingroup    %
                   !parskip=0pt %
                   !xiipt       %
                   !def!par<!hss!egroup!endgraf!hbox to !hsize!bgroup!hss>%
                   !obeylines   %
```

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```
                          !hbox to !hsize!bgroup!hss%
                      >                     %
!def!endaddress<!hss!egroup!endgraf!endgroup!par>%
!def!theaddress <!beginaddress
                      Department of Automatic Control
                      Lund Institute of Technology
                      Box 118, S-221 00 Lund
                      Sweden
                      !endaddress    %
                  >                  %
        >                            %
   >                                 % end of !obeylines
!let!endtitleslide=!endslide
%
<!obeylines%
!gdef!begincontentsslide<!beginslide <The Contents Slide>%
!Bigcenterline<Contents:>       %
!medskip%
% !def!par##1<!ifx##1!endcontentsslide!else%
%            !item <$!star$> <##1>!fi%
%         >
!parskip=!bigskipamount
!def!par<!item <$!star$>              >
!obeylines                  %
!let!par=!endgraf           %
  >
>
%
!let!endcontentsslide=!endslide
%
!let!black=!relax              % Fix multicolor later
!let!red=!relax
!let!orange=!relax
!let!yellow=!relax
!let!green=!relax
!let!blue=!relax
!let!purple=!relax
!let!brown=!relax
%
!long!def!proclaim #1. #2!endproclaim%
  <!medbreak
    !noindent<!bf#1.!enspace>
    <!sl#2>!endproclaim%
    !ifdim!lastskip!<!medskipamount!removelastskip%
    !penalty55!medskip!fi%
  >
!def!endproclaim<!par!noindent!ignorespaces>
%
% Small macros
!def!sp<!mathop<!rm sp>!nolimits> % same as ^ in Plain
!def!mod<!mathop<!rm mod>!nolimits> % same as ^ in Plain
!let!|=!Vert                      % altset !!
!def!!<!char"21>
%
%
% ************** Blackbord-bold fonts **************************
%
!def!streck<!hbox <!vbox <!vfill !hrule width 0.5pt height 6pt !vskip 0.7pt>>>
!def!complexC<!hbox<!hskip 1.5pt !streck !hskip -3.2pt <!rm C>>>
!def!rationalQ<!hbox< !streck !hskip -3pt <!rm Q>>>
!def!negativethinspace<!mskip-!thinmuskip>
!def!realR<!hbox<$!rm I !negativethinspace R $>>
% !def!complexC<!hbox<$!rm I !negativethinspace !negativethinspace
```

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```
%                           !negativethinspace C $>>
% !def!rationalQ<!hbox<$!rm I !negativethinspace !negativethinspace
%                           !negativethinspace Q $>>
!def!integerZ<!hbox<$!rm Z !negativethinspace  !negativethinspace Z $>>
!def!bbbT<!hbox<$!rm T !negativethinspace
                       !negativethinspace !negativethinspace T $>>
!def!naturalN<!hbox<$!rm I !negativethinspace N $>>
!def!bbbM<!hbox<$!rm I !negativethinspace M $>>
!def!bbbI<!hbox<$!rm I !negativethinspace I $>>
%
%
% Some math-constructions, inspired by AmSTeX
%
!def!align #1!endalign<!eqalign<#1>>
!let!endalign=!relax
!def !frac #1#2<<#1 !over #2>>
!def!to<!relax>
!def!undersetbrace #1!to #2<!underbrace<#2>_<#1>>
%
%
% Styles
!let!heading=!Bigcenterline
!def!section#1<!vskip !bigskipamount!Bigcenterline<#1>>
!let!scriptscriptstyle=!scriptstyle % for readability
!scriptscriptfont0=!sevenrm
!scriptscriptfont1=!seveni
!scriptscriptfont2=!sevensy
%
!font!hugefont = ambx10 scaled 1500
!font!Bigfont = ambx10 scaled 1250
!font!bigfont = amssi10
!font!headlinefont = amr10 scaled 500
%
!mag=2073  % ???? BM
!hsize=180 true mm  % was 170
!vsize=265 truemm % was 250 true mm
!hoffset -10 true mm
!pretolerance=2000 !tolerance=100
!raggedright
%
!let!item=!leftitem
!parindent=0pt !itemmarg=2  em
!parskip=!medskipamount
```

Appendix 3: Letter

```
!def!today<!ifcase!month!or
           January!or February!or March!or April!or May!or June!or
           July!or August!or September!or October!or November!or December!fi
           !space!number!day, !number!year>
!raggedbottom
!interlinepenalty=1000
!hsize=6.25truein
!voffset=24pt
!advance!vsize by-!voffset
!parindent=0pt
!parskip=0pt
!nopagenumbers
```

```
!headline=<!ifnum!pageno=3
  !tenrm To !addressee!hfil!today!hfil Page !folio
  !else!hfil!fi>
!headline=<!ifnum!pageno=4
  !tenrm To !addressee!hfil!today!hfil Page !folio
  !else!hfil!fi>
!headline=<!ifnum!pageno=5
  !tenrm To !addressee!hfil!today!hfil Page !folio
  !else!hfil!fi>                                        % Fix by JEL
!headline=<!ifnum!pageno=2                              % Fix by JEL
  !tenrm To !addressee!hfil!today!hfil Page !folio
  !else!hfil!fi>
!def!beginlinemode<!endmode
                 !begingroup!obeylines!def!endmode<!par!endgroup>>
!def!beginparmode<!endmode
                 !begingroup!parskip=!medskipamount
                 !def!endmode<!par!endgroup>>
!let!endmode=!par
!def!endletter<!endmode!vfill!supereject>
!newdimen!longindentation !longindentation=4truein
!newbox!theaddress
!def!address<!beginlinemode!getaddress>
<!obeylines!gdef!getaddress #1
  #2
  <#1!gdef!addressee<#2>%
    !global!setbox!theaddress=!vbox!bgroup!raggedright%
    !hsize=!longindentation !everypar<!hangindent2em>#2
    !def!endmode<!egroup!endgroup !copy!theaddress !bigskip>>>
!def!body<!beginparmode>
!def!closing<!beginlinemode!getclosing>
<!obeylines!gdef!getclosing #1
  #2
  <#1!nobreak!bigskip !leftskip=!longindentation #2
    !nobreak!bigskip!bigskip!bigskip % space for signature
    !def
    <!endgraf!nobreak>>>
!def!annotations<!beginlinemode!def!par<!endgraf!nobreak>!obeylines!par>
!def!ps<!beginparmode!nobreak
        !interlinepenalty5000!def!par<!endgraf!penalty5000>>
!def!up#1<!leavevmode !raise.16ex!hbox<#1>>
!font!smallheadfont=amr8 at 8truept          % Was cmr 8
!font!largeheadfont=amdunh10 at 14.4truept   % Was cmdunh10
!font!logofont=manfnt at 14.4truept
!def!!<!char"21>
!def!BM<Bengt M!aa rtensson>
!def!BMletterheadwithhomephone<
!def!sendingaddress<!BM!par
                 Int-46-46-108790!par
                 Int-46-46-141628 (home)!par
                 UUCP:$!ldots$!!mcvax!!enea!!agaton!!bode!!bengt!par
              >
!def!returnaddress<Dr. !BM!par
                 Department of Automatic Control!par
                 Lund Institute of Technology!par
                 P.O. Box 118, S-221 00 LUND, Sweden>
  !letterhead>
!def!BMletterhead<
!def!sendingaddress<!BM!par
                 Int-46-46-108790!par
%                 Int-46-46-141628 (home)!par
                 UUCP:$!ldots$!!mcvax!!enea!!agaton!!bode!!bengt!par
              >
```

```
!def!returnaddress<Dr. !BM!par
                    Department of Automatic Control!par
                    Lund Institute of Technology!par
                    Box 118, S-221 00 LUND, Sweden>
   !letterhead>
!def!letterhead<!pageno=1!def!addressee<> % !univletterhead
  <                                  % !leftskip=!longindentation
   <!baselineskip9truept!smallheadfont!sendingaddress>
    !bigskip!bigskip!rm!hskip !longindentation!today!bigskip>>
!def!univletterhead<!vglue-!voffset
   !hbox<!hbox to!longindentation<!raise4truemm!hbox<!logofont
       !kern2truept X!kern-1.667truept
       !lower2truept!hbox<X>!kern-1.667truept X>!hfil
     !largeheadfont Dept. of Automatic Control!hfil>%
   !kern-!longindentation
   !vbox<!smallheadfont!baselineskip9truept
     !leftskip=!longindentation Lund Institute of Technology!par
        Box 118, S-221 00 LUND, Sweden>>
  !vskip2truept!hrule!vskip4truept >
!def!makelabel<!endletter!hbox<!vrule
   !vbox<!hrule !kern6truept
     !hbox<!kern6truept!vbox to 2truein<!hsize=!longindentation
           !smallheadfont!baselineskip9truept!returnaddress
           !vfill!moveright 2truein!copy!theaddress!vfill>%
        !kern6truept>!kern6truept!hrule>!vrule>
  !pageno=0!vfill!eject>
```

Appendix 4: Tentamac

```
% Tentamac
% LastEditDate="Mon Aug 25 21:54:21 1986"
!def!trueafour<!hsize 140truemm  % 210mm - 1in * 2 for margins
!vsize 246truemm  % 297mm - 1in * 2 for margins
!advance !vsize by -24 pt
!topskip=10pt plus 1 pt
!qscale=1000 !loadfonts !tenpoint>
%
!magnification=1095
!trueafour
!hoffset=15mm
!parindent=0pt
!parskip=!medskipamount
!newdimen!nuffraindent !nuffraindent=8mm
!newdimen!problemskip!newdimen!subproblemskip
!problemskip=!bigskipamount !subproblemskip=!medskipamount
!newcount!problemno !newcount!previousproblemno
!newcount!figureno !newcount!nextfigureno
!problemno=0!previousproblemno=-1
!figureno=0!nextfigureno=1
!def!nextfigure<!the!nextfigureno>
!def!previousfigure<!the!figureno>
!def!previousproblem<!the!previousproblemno>
!def!thisproblem<!the!problemno>
!def!date<!number!year-!number!month-!number!day:!enspace!number!time>
!def!finalversion<!let!date=!relax>
!headline<!hfill>
!footline<!hfill!rm!date!hfill>
!tolerance=3000
```

```
!def!problem <!advance!problemno by 1!advance!previousproblemno by 1
    !vskip !problemskip!hskip-!nuffraindent!hbox to!nuffraindent
    <!bf !the!problemno. !hfill>!ignorespaces>
!def!subproblem #1 <!vskip !subproblemskip!hskip-!nuffraindent
      !hbox to!nuffraindent<!hfill<!bf #1)>!hfill>!ignorespaces>
!def!problemsubproblem #1 <!advance!problemno by 1
      !advance!previousproblemno by 1
      !vskip !problemskip
      !hskip-!nuffraindent!hbox to!nuffraindent
      <!bf !the!problemno#1)!hfill>!ignorespaces>
!def!points#1<<!unskip!nobreak!hfil!penalty50!hskip1em!hbox<>
!nobreak!hfil(#1 p)!parfillskip=0pt!finalhyphendemerits=0!par>>
!def!figure #1 #2 <!advance!figureno by 1
      !advance!nextfigureno by 1
      !midinsert !vglue #2 !centerline<<!bf Figur !the!figureno.>
        #1>
      !endinsert>
%
!def!!<!char"21>
!def!Matrix#1<!left!lgroup!matrix<#1>!right!rgroup>
!def!Re<!hbox<!rm Re !kern 0.3mm>>
!def!Im<!hbox<!rm Im !kern 0.3mm>>
%
!def!begintitlepage<!begingroup
    <!xiipt!bf
      !leftline<Institutionen f|¿r Reglerteknik>
      !leftline<Tekniska H|¿gskolan i Lund>
    >
    !vfill
    !def!examtitle ##1 <!centerline<<!xxipt!bf ##1>>
  !medskip>
    !def!examdate ##1 ##2 <!xdef!examdatezzz<##1>
    !centerline<<!xiipt !sl
  Tentamen ##1
  kl ##2>>
    !vskip 15mm>
    !def!endtitlepage<!vfill!endgroup!eject
!headline=<!hglue -!nuffraindent%
    !it!examdatezzz!hfill
    Sida !folio>
      >
  >
!def!examresult<
  !def!heading ##1<<!xiipt!bf ##1!smallskip>>
  !heading<Poängberäkning och betygsättning>
  L|¿sningar och svar till alla
  uppgifter skall vara klart motiverade.
  Tentamen omfattar totalt 25 poäng.
  Poängsättningen finns markerad
  vid varje uppgift.
  !medskip
  Betygsgränser:
  !medskip
  !vbox<!halign<!hfil## &: ##!hfil!cr
Betyg 3& h|¿gst 12 poäng !cr
4& h|¿gst 17 poäng !cr
5& h|¿gst 22 poäng !cr>>
  !medskip
  !heading<Tillåtna hjälpmedel>
  Matematiska tabeller (TEFYMA eller
```

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```
motsvarande), formelsamling i
reglerteknik samt icke
f|¿rprogrammerade räknare.
!medskip
!heading<Tentamensresultat>
      >
%
%
!def!solutions #1<!headline=<!hglue -!nuffraindent!it #1!hfill Sida !folio>
    !problemskip=!medskipamount
    !subproblemskip=!medskipamount>
```

DVILW

DVI to PostScript filter adapted to LaserWriter

Bengt Mårtensson, 860903
Revised 860907, BM
Revised 860913, BM
Revised 861002, BM

This paper documents the program DVILW that translates a TEX DVI-file to the page-description language PostScript, adapted to the Apple LaserWriter, and optionally prints it. The handling of TEX's special-command is fully documented. This paper is compatible with the version of DVILW which is dated October 2, 1986. It is my intention that this paper should be updated when the program is updated.

1. Introduction

DVILW is the latest version of a program for reading TEX .DVI-files. It has been around in different guises, e.g. under the name DVILGP. The lastest modifications has been done by Leif Andersson and Bengt Mårtensson. It is approximately 2000 lines of pascal, and runs under VAX/VMS version 4.x. The PostScript file is roughly "conforming", e.g. containing machine readable comments as described in [Adobe, Appendix C].

Convention. *The escape-character of TEX, "\" in Plain TEX, is represented as "!" in this paper. Furthermore, begin-group and end-group ("{" and "}" in PlainTEX) are represented as "<" and ">".*

2. Function

Basic Operation
The program is run by the command dvilw[/⟨options⟩] *file_name* where *file_name* is the name of the DVI-file. Default file-type is dvi. By default, DVILW creates a PostScript

file with the name *file_name.ps.* If the print-option is selected (which is default), the file is printed on the LaserWriter.

DVILW requires that the logical name `ps$inputs` to be defined and the existence of the file `ps$inputs:tex.pro`. This is a prolog-file added to the output file. It is based on, but not identical to the prolog file used by the program DVI2PS, which also was used in previous versions of DVILW.

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.

/inquire *(Default)* /noinquire /nospecial
These qualifiers govern the treatment of the !special-command. The /nospecial qualifier makes DVILW ignore the !special-command. The /inquire qualifier makes DVILW inquire for a new file name when a requested special file is not found. An empty file name (e.g. just return) will make DVILW ignore the file. If the /noinquire qualifier is given DVILW will ignore not found special-files. (E.g. for running DVILW in batch mode.) The exact handling of the !special-command is documented in the next section.

/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.

/copies=*number_of_copies*
This makes every page be printed *number_of_copies* number of times. The job will come out unordered, but this is much faster than sending multiple jobs. Requests to make less than one copy are ignored.

/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 upper left hand corner and the edges of the paper. Unit is mm, and no other unit is supported. Default is 25 mm for each. The qualifiers work in the same way both in portrait- and landscape mode. Needless to say, physical limitations restrict the meaningful values.

/rmagnification=*magnification* /amagnification=*magnification*

These qualifiers modify the magnification of the document. amagnification overrides the magnification, while rmagnification multiplies it. The parameter is divided by 1000, e.g. amagnification=1200 means a magnification by a factor 1.2.

/terse *(Default)* /quiet
The qualifier quiet inhibits some printout on the screen on number of pages etc.

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

/pages=*page_range_specs*
This option will produce only the pages in the *page_range_specs*. A *page_range_specs* consists of one or several page-ranges, separated by commas. A page-range is either a number or two numbers separated by colon (:). Examples are: a) 5 b) -7:0 c) -8:-5,1:5,15,-1:0. The page-numbers are the actual page numbers printed on the pages by TeX, not the consecutive number in the file. These are not necessarily the same. Note that negative page numbers are allowed. (These will be printed as lower case roman numerals by the PlainTeX-command !folio.)

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. dvips == "''dvilw/noprint'". amagnification and rmagnification are considered as conflicting.

Qualifiers Not to be Used by Normal Users
There are also some qualifiers that are not to be used by the normal user. They exist for debugging purposes or historical reasons, and might disappear in coming versions.

/logfile=*file_name*
This gives the log file a different name. There is presently no log file.

/errorsonly /terse *(Default)* /verbose /debug
These qualifiers govern how much debugging information is written on the screen. /errorsonly is synonymous with quiet. The use of this is limited, since the PostScript file is a human readable text file, which can be read and modified using any text editor.

3. Handling of !special

The !special<*file_name*> command in TeX makes DVILW include the file *file_name* in the output file. Several file names can be given, separated by commas, spaces, or pluses. Default file type is pro. If *file_name* is not found, then ps$inputs:*file_name* is sought for. Note that ps$inputs can be a search list. Also user-supplied file names (by the /inquire qualifier) are sought for in this fashion.

The alignment is done so that (roughly) the upper left corner of the inserted "page" is placed where the dot presently is located. More precisely, the point where the dot is located corresponds exactly to the point with coordinates (0,820) in the default PostScript coordinate system.

Strings of PostScript code can be inserted by enclosing them in double quotes ("). Note that the argument of !special is expanded. TeX recognizes the comment sign (%) in the argument, but not e.g. dollar signs ($).

The PostScript operators showpage and erasepage are disabled (e.g. redefined to do nothing) in a !special. Therefore, plots etc which print by itself should be possible to use without modification.

Ordinarily, the current PostScript status is restored after the execution of the !special command. However, if the first character in the argument to special is '@', then this is not done, and the global changes can be done. The primary use of this is to include prologue-files needed for several inserts. Example: !special<@plotdict> will insert ⟨ps$inputs:⟩plotdict.pro so that all subsequent !special files will have access to the definitions in plotdict. (Note, however, that the pages are sent to the LaserWriter in opposite order. Therefore, a global insert will have effect on previous pages, but not on the following.)

A !special command is either local or global (i.e. starting with a leading "@"). Local and global effects are not allowed in the same !special.

The rest of this section can be skipped by the average user. Next a detailed description of the implementation is given. The reader is assumed to be familiar with PostScript. When !special is encountered, first a saveset is created. After pushing the coordinates of the current points on the stack, initgraphics is performed, which restores the graphics state to default. If landscape-mode is in effect, the coordinates are rotated and translated accordingly. Then the old coordinates of the current point are used in order to translate the coordinate system according to the description above. Then the file and/or the PostScript code is inserted. After this, the saveset is used in order to restore the graphics state as it was before !special was handled.

For global !special's—i.e. when the argument starts with "@", as described above— the file and/or Postscript code is not embedded in save/restore pairs. Thus it will impact futute save-sets. No initgraphics is performed, and no redefinition of print-page and erasepage takes place.

4. Handling of Fonts

DVILW handles the usual TeXfonts as pxl-files. These are supposed to have file names such as tex$disk:<tex82.pxl.1500pxl>amr10.pxl. There is no provision for alternative pixel areas in the present version.

The LaserWriter Plus contains the fonts listed in Figure 1. The fonts marked with

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

Figure 1. List of PostScript names for LaserWriter Fonts.

(*) are present also in the LaserWriter without "Plus". The names listed are the PostScript names. Note that the case of the letters are significant in PostScript. The list has been obtained by inquiring the LaserWriter directly, so it is guaranteed free of typos. The TEXname is formed from this by replacing all letters by lower case and deleting all hyphens ("-"). DVILW recognizes the TEXname for these fonts and creates the appropriate PostScript code. (Presently, DVILW does not set up the parameters for these fonts properly.) The font size is presently set so that scaling 1000 represent a font that is 10 bigpoints high, but in the future this information should be read from the tfm-file. Example: !font!zapf=zapfchancerymediumitalic scaled 1200 will give the 12bpt TEXfont zapf.

When loading a pixelfont, DVILW searches at the font directory with the pixel size which is the closest to the computed one. If there is a discrepancy of more than 1%, a warning will be issued on the terminal.

When a pxl-file is not found, this is reported on the terminal, and the missing font replaced by Courier.

5. Hints and Tips

Large Sides

Pages larger than the usual printing area can be output by printing them repeatedly with different values of xoffset and/or yoffset, and then cut and glued together afterwards. Example: To produce a 300 mm long page you just write it in TEX as if you could print 300 mm long pages. Then print it with the commands dvilw file and dvilw/yoffset=-100 file. Cut and glue it afterwards.

6. Discussion, Bugs, Problems, and Possible Improvements

The LaserWriter Barfs!

The major problem presently is not the program, it is the LaserWriter. The size of its virtual memory is simply not adequate for printing complex TeX-document with down-loaded fonts. I have frequently exhausted the virtual memory only by 2–3 pages! Hopefully, there will soon be available more virtual memory. Until then, you have to process the files just a few pages a time. The amount is dependent on the number of fonts you use, and how large they are. Note that if no Macintosh job has been sent to the LaserWriter since powerup, the available virtual memory will increase.

Using the LaserWriter's Resident Fonts

The LaserWriter (in particular LaserWriter Plus) contains several beautiful fonts. The major effort to do this is to create tfm-files corresponding to the Adobe afm-files. After this, DVILW should be modified in order to read parameters from the tfm-files. Also, an "invisible" font (all entries are blank, but with all parameters copied from another font) should be created for making color slides, by splitting the different colors on different sheets á la SliTeX. The ligatures also present problems. Outlined, underlined, or reencoded fonts can be created.

What is the Best Implementation of !special?

In [Knuth] the command !special is defined only to include its arguments in the DVI-file as information to the DVI-handling program. There is also the requirement that the DVI-handler is not allowed to modify the position of the dot during handling of the !special command.

The selection of the alignment is only one of several possible. I think it is the most natural for the TeX user who wants to fit a given PostScript figure, presented on a sheet of paper, into his document. From the point of view of PostScript's default coordinate system, with the origin in the lower left corner, it is less natural. E.g. with another paper format (such as $8\frac{1}{2} \times 11$ inches) there will be a misalignment. The pertinent parameters are defined as const's in the Pascal program, and is therefore easy to change, though.

Inclusion in Other Documents

In order to allow inclusion in other documents, global changes such as scaling, translation and rotation, there must not be any PostScript command in the file that forces any changes of the graphical state in terms of absolute quantities, only by modifying the old state. Due to what I consider a flaw in PostScript, (no named graphic savesets, and the implicit grestore performed by restore) this has requirement has been fulfilled only "almost". There are only two PostScript command in the generated PostScript code that is not compatible with this requirement: initgraphics and showpage, so only these have to be redefined in order to allow inclusion or global changes. Example: writing

```
<
!catcode'{=12!catcode'}=12
!special<@"/oldinitgraphics { initgraphics } bind def
          /initgraphics { oldinitgraphics 15 rotate } def">
```

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>

in the last page of your document will make the entire document, including all !special's come out rotated 15 degrees counter-clockwise.

Other Future Improvements

The program should read the parameters for resident fonts from tfm-files properly. Some optimization will reduce the size of the generated PostScript file by 50–20%. Possibly some improvement of the execution speed is possible, especially since the program DVILGP runs considerably faster. Possibility to force global !special inserts to the beginning of the file??

7. Revision History

86-09-07 (BM) Treatment of special changed to allow multiple files and quoted Post-Script strings.

86-09-13 (BM) Changed the initial coordinate transformation. The old ond forced absolute numbers into the current transformation matrix (CTM) in PostScript, thereby making it impossible to relocate, scale, rotate, or translate a document in its entirety. Special-handling defined in terms of PostScript coordinates (0,820).

86-10-02 (LA) Corrected error in setRule and setChar.

86-10-02 (BM) Cleaned up PostScript coordinate transformations. Allowed global !special's. Disabling of showpage and erasepage in handling of special. Search for !special-files on ps$inputs. The /inquire qualifier introduced. Changed the old name of /special to /noinquire. Introduced warning for substituting pixel-sizes. Allowed use of resident fonts, except for loading of parameters from .tfm-files. Replacement of not found pxlfonts. Handling of multiple page ranges improved. /amagnification and /rmagnification implemented. The prologue modified.

References

ADOBE SYSTEMS INCORPORATED (1985): *PostScript Language Reference Manual*, Addison-Wesley, Reading, MA.

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