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Compact T_EX

Leif Andersson

Second edition

Department of Automatic Control
Lund Institute of Technology
June 1989

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| <i>Abstract</i> <p>A macro package for T_EX, used at the department, is described. Extensive examples are given of its use. Reading advice for beginners is also included. This is the second edition of Compact T_EX.</p> | | | |
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The report may be ordered from the Department of Automatic Control or borrowed through the University Library 2, Box 1010, S-221 03 Lund, Sweden, Telex: 33248 lubbis lund.

1. Introduction

This report is a compact reference manual for the \TeX macro package used at the Department of Automatic Control, Lund Institute of Technology. The macros are built on top of Plain \TeX , and almost all functions of Plain have been retained. The package is much less powerful than \LaTeX , but believed to be easier to use since it is tuned to the particular needs of the Department.

The comments and constructive criticism from Eva Dagnegård, both on the actual page designs and on this report are gratefully acknowledged.

This is the second edition of a report describing an evolving package. It may be followed by revised editions.

2. Absolute Beginners

The definitive source for \TeX information is “The \TeX book” by D. E. Knuth. It is, however, quite thick, and it is difficult for a beginner to find the information that he needs to start making simple things. A suggested subset to start with is the following: Preface, pages 7, 8, 13, 14, 19, 20, 24, 25, 37, 38. Do not read the Dangerous Bend paragraphs!

There is a section later in this report called “Styles.” Beginners should read the introduction to that section and also the subsections `\style report` and `\style pm`. Read the other subsections as and when they are needed.

Apart from the commands mentioned in this report, a small number of commands from Plain \TeX may be useful: `\par`, `\smallskip`, `\medskip`, `\bigskip`, `\vskip`, `\vglue`, `\enskip`, `\quad`, `\input`, `\settabs`, `\noindent`. Use the index of the \TeX book to find them.

The really strong point of \TeX is mathematical text. There is no way to describe the mathematical mode of \TeX that is better than chapters 16 through 19 of The \TeX book. They are surprisingly easy to read, and contain lots of good examples.

There should be an accompanying document with the title “Compact \TeX Local Guide” or similar, that contains information about the operating system commands that are used on your system to process and print the \TeX files.

3. Chapters and Sections

`\chapter 3 {The Chapter Heading}` Note the space between chapter number and chapter title. The “chapter number” may in fact also be a letter.

To get a chapter title without a chapter number, use an empty group, i.e., `\chapter {} {The Chapter Heading}`. The chapter number is available inside the chapter as `\ch`.

`\endchapter` Outputs any remaining pictures etc. Makes subsequent text start on a new page.

`\section{Section Heading}`

`\subsect{Subsection Heading}`

`\subsubsect{Lower level heading}`

If a heading is too long to fit on one line it may be broken with a double backslash (`\`)

Sections and subsections may be automatically numbered. This automatic numbering is turned on and off with `\sectionnumbers`, `\nosectionnumbers`, `\subsectnumbers`, `\nosubsectnumbers` respectively. The defaults are `\sectionnumbers` and `\nosubsectnumbers`.

4. Figures and Figure Captions

For a discussion of figures, see Knuth pp. 115–116. Apart from `\topinsert` and `\midinsert`, Compact T_EX also has a command pair `\bottominsert`–`\endinsert`, which will put the figure at the bottom of the page. This command should be used only at the last stages of document preparation, when it has been determined on which page the figure will fall. Figures are also put at the bottom of the page if it is the first page of a chapter.

The figure captions are set with the following commands, which all have automatic numbering.

```
\figure{The figure caption}
  \butlastfig, \lastfig, \nextfig  The numbers of the second last,
  last or next figure. It is often necessary to write an extra escape character,
  i.e., \lastfig\ in order to get a space after the number. See the discussion
  in the TEXbook page 8.
\listing{A Program}
  \butlastlist, \lastlist, \nextlist  see \figure.
\table{A Table}
  \butlasttable, \lasttable, \nexttable  see \figure.
```

5. Math Headings

All the following have automatic numbering. Note that if there is no text in the heading, an empty group is still necessary. Long headings may be broken with a double backslash.

```
\example{The example heading}
\algorithm{Algorithm heading}
\theorem{}
\lemma{}
\definition{}
\result{}
```

The following are not automatically numbered.

```
\proof  Note, no argument.
\remark{3}
```

6. Mathematics

Very little has been added to the commands described in chapters 16 through 19 of the T_EXbook.

`\eqalign` allows more than one tab, otherwise just as The T_EXbook.

`\leftdisplay` Displays are normally centered. This command makes subsequent displays appear left adjusted ca 10 mm from the left margin.

Equation Numbering

`\autoeqno`, `\noautoeqno` Turns automatic equation numbering on or off. If `\noautoeqno` then follow the `TeXbook`, otherwise use only the command `\eqno` with no argument. `\autoeqno` is the default.

`\nexteq`, `\lasteq`, `\butlasteq` The numbers of the next, last and second last equation, if `\autoeqno`.

Special Equation Numbering

Even if automatic equation numbering is on, it is sometimes desirable to have numbers like (2.33b) or (1.13') or similar.

`\maneqno` The equation number may be set manually with this command even if `\eqno` gives automatic numbering.

`\inceqno` Increments the equation number.

A typical command sequence to get an equation number like (2.33a) following (2.32) would thus be `\inceqno \maneqno{(\lasteq \rm a)}`

7. Itemization

`\item{1.}` The first entry, which may be followed by a fairly long text reaching over more than one line.

`\item{2.}` The second entry.

`\itemskip`

The input text above would produce:

1. The first entry, which may be followed by a fairly long text reaching over more than one line.
2. The second entry.

Note the `\itemskip` after the last item. The amount skipped may be set by the parameter `\itemskipamount`, default 3pt.

`\itemwidth{Longitem}` Sets the margin in a list of items such that the entry 'Longitem' will fit. The default value is 20 pt (ca 7.5 mm). The margin may also be set directly with the parameter `\itemmarg`.

`\itemitem{a.}` Gives items inside items.

`\itemitemwidth{a.}` Sets the margin for `\itemitem`. Default 20 pt.

`\itempar` New paragraph inside an `\item` entry. Note that ordinary `\par` will give the following text the wrong margin.

`\itemitempar` New paragraph inside an `\itemitem` entry.

`\leftitem` makes subsequent item entries left justified (default).

`\rightitem` makes subsequent item entries right justified.

There are two predefined items:

- This entry is made with the command `\bullet`
- And this with the command `\circ`

Problems and subproblems

A special application of itemization is problem and subproblem numbering. See also `\style problems` which describes a slightly different implementation.

`\problem` Gives an automatically incremented problem number in the form of an `\item`.

`\problemwidth{\bf 5.10}` sets the margin for the `\problem`. The example shown here has in fact the default width.

`\problempar` New paragraph inside a `\problem`.

`\subproblem{a}` looks like `\itemitem`

`\subproblemwidth{a}` sets the width of the subproblem margin.

`\subproblempar` New paragraph inside a `\subproblem`.

8. Fonts and Font Sizes

The following commands change the font sizes. They not only change the fonts, they also change the relevant line distances etc. The font size commands also make an implicit `\rm` command. This paper is written with font size `\xipt`. The reason that the font sizes are given with roman numerals is that T_EX doesn't accept digits as part of commands.

`\viiipt`, `\ixpt`, `\xpt`, `\xipt`, `\xiipt`, `\xivpt`, `\xvipt`, `\xxipt`, `\xxvpt`,
`\xxxpt`, `\xxxvipt`

The font types are

`\rm` roman `\bf` bold-face `\sl` slanted `\it` italics `\itbf` *italic-bold-face*
`\csc` CAPS-AND-SMALL-CAPS `\ss` sans-serif `\sssl` *sans-serif slanted* `\tt`
teletype font.

9. Footnotes

For a discussion of footnotes, see the T_EXbook pp 116–117. To summarize: in order to make a footnote*, you should write:

...make a footnote `\footnote*{Like this}`, you should...

The character following the `\footnote` command is the marker for the footnote. Other common choices are `\dag` (†), `\ddag` (‡) and digits. If the footnote marker is more than one character, enclose it in a group. Footnotes may also be automatically numbered, with the numbering contiguous within a chapter. This automatic numbering is turned on and off with `\footnotenumbers` and `\nofootnotenumbers` (default) respectively. If footnotes are automatically¹ numbered, there should of course be no marker character(s).

...automatically `\footnote{Automatic number}` numbered...

10. Reference Lists

The Reference commands will handle all the intricacies of punctuation and choice of fonts for a bibliography. The individual items inside a reference entry may be specified in any order, and will be automatically reordered according to the standard format. No grouping is necessary for these commands. See the extensive example in the example part.

`\references...\endreferences` delimit a reference section. The chapter or section specification should be *after* the `\references` command. See the examples.

* Like this

¹ Automatic number

`\bref... \endref` delimit a reference entry. Normally the author(s) should be written immediately after `\bref`. Use ~ instead of space between initials and between name and initials.

`\and`, `\ed`, `\eds` little words that appear between or after author names. They are commands because the author names are often in another font than the plain text.

`\year` Publishing year.

`\report \reportinfo` The title of a report and possible extra information.

`\paper \paperinfo` The title of a paper and possible extra information.

`\journal \vol \issue` The title, volume id and issue id of a journal.

`\inref` If a paper is part of a book, then the editor's name, i.e., the name on the title page of the book.

`\book \bookinfo` The title of a book, and possible extra information.

`\publ \publaddr` The publishers name and address.

`\page \pages` The page number(s) for a paper in a journal or book.

`\finalinfo` Any other information.

Some of these commands are only meaningful in certain contexts. `\bookinfo` can appear only with `\book`, `\paperinfo` only with `\paper`, and `\reportinfo` only with `\report`. `\vol` and `\issue` can appear only with `\journal`. A command that is used in the wrong context will generate no output, and there will be no error message.

The reference entries may have an automatically generated number within brackets in front of them. This numbering is turned on and off with `\referencenumbers` and `\noperencenumbers` (default) respectively.

11. Program Lists and Command Dialogs

`\verbatim filename` will insert the requested file verbatim with no interpretation of any characters, with the line breaking and horizontal spacing preserved and using this font.

`\verbatim @` Defines the character after the command `\verbatim` to be a special control character, such that any text between two of these characters appears verbatim with no interpretation, including line breaks. It is possible to use any character as the special character. To put the special character in such verbatim text, use the command `\verbch`.

Example:

This text contains both \, { and @ characters.

The previous line was produced with the input text

Example:@

This text contains both \,{ and @\verbch@ characters.

@ The previous line was produced...

12. Table of Contents

It is common to have the table of contents at the beginning of a document, but it cannot be created until the entire document has been processed. The solution to this problem is to have T_EX generate an intermediate file with the necessary information about section headings, page numbers etc, and then process this file after the other parts of the documents. The resulting table of

contents is then itself given page numbering such that it fits in at the beginning of the document. The name of the intermediate file is derived from the name of the main file: If the main file is called `entirebook.tex` then the intermediate file is `entirebook.toc`.

`\contentshere 3` Creates the intermediate file for table of contents information. This command should appear at the position near the beginning of the document where the table of contents is wanted. The number should be an estimate of its size in pages so that a suitable range of page numbers may be allocated.

`\contents entirebook` Process the table of contents file.

A typical main file (`entirebook.tex`) for a large document would be:

```
\style book
\input titlepage
\contentshere 2
\input chap1
...
\input chap10
\bye
```

And the file to process the table of contents:

```
\style book
\chapter {} {Table of Contents}
\contents entirebook
\bye
```

13. Cross Reference

The automatically numbered items, such as figures, tables, equations etc. can be referenced locally with `\lastfig`, `\lasttable`, `\lasteq` etc., as has been described earlier. Reference over longer distances is done by having `TEX` associate the automatically generated numbers with user-supplied labels.

`\label{name}` Associates `name` with the immediately preceding automatically generated number. `name` may be any string of characters that are not special to `TEX`, and should of course be chosen so that it is easy to remember. Labels and their values are written in the right-hand margin in the default draft modes. Multiple use of the same name is an error, and an error message will be written to the terminal.

`\xref{name}` Inserts the number associated with `name`. If `name` has not been defined in a `\label` command then three boldface questionmarks are inserted and an error message written to the terminal.

The commands `\label` and `\xref` allow for backwards reference only. Forward reference would require a two pass scheme, and this is undesirable. Instead the user may predefine a label to have a certain value.

`\prelabel{name}{4.3}` Define `name` to have the value 4.3. The advantage of using `\prelabel`, `\xref` and `\label` instead of just inserting the numbers manually is that when the `\label` command is encountered, then its value will be compared with the `\prelabel`, and if they are different an error message will be written to the terminal.

14. Index

`\logfileout` Opens a log file for index entries.

`\index{index word}` If the log file is open, writes the entry there for later processing by an index program, and if not `\finalversion` then also writes the entry in the right margin. Assuming the main file is called `mybook.tex`, the command to process the log file is `texindex mybook` both to VMS and to Unix. The resulting file is `mybook.idx`

`\beginindex \input mybook.idx \endindex` The output from the index program mentioned above is processed and typeset in two columns.

15. Styles

The actual format used for a document will be determined by the so called *style file*, which is a small file with commands for page size, heading fonts etc. As an example, the command `\style book` will input the file `book.sty` from the standard input path (see the Local Guide), provided it is the first time. If the command `\style book` appears again, it is a null command, but all other `\style` commands are still valid. The `\style` command should therefore appear first in every file of a multi-file document, so that it will be easy to process small parts of the document.

By default a draft mode is used, where the current date and time is printed at the bottom of each page, and any margin information (see e.g. the section on Index) is printed in the margin. Many formats described below have a command `\finalversion`, which suppresses this information.

`\style report`

This is a format suitable for reports that will be published in A4 format or similar. It is the format used for this document itself. There are a few commands internal to this style:

`\finalversion` suppresses the date and index information. Also moves the text so that it is right justified on the pages.

`\doubleface` Makes the page offset different on even- and odd-numbered pages so that it is suitable for double face printing. This command is only defined after `\finalversion` has been given.

`\style pm`

This format is for short internal papers.

`\style book`

Suitable for dissertations etc. The chapter openings are more elaborate than in other formats and there are running headlines containing chapter and section names.

`\finalversion` removes the date and index information.

`\style proof`

This format is designed for proofreading. The margins are reasonably wide and the line spacing is larger than normal to facilitate markings etc.

`\style letter`

Intended for letters. See also the example at the end of this report.

`\address` Write the name and address of the recipient after this command.

`\body` The actual text of the letter follows.

`\closing` Greetings and signature.

`\ps` The PS if any.

`\cc` A cc: list that is put at the bottom of the page.

The current date is put at the top of the letter. If you want another date or another format for the date, put the command `\def \date{The date you want}` before the command `\style letter`.

`\style slides`

A format designed for overhead transparencies. A sans-serif font is used for the text, which is magnified by a factor of two and vertically centered.

`\centerhead{The title of the slide}` A centered headline, larger than the plain text.

`\lefthead{Another title}` A left-adjusted headline, same size as `\centerhead`.

`\Bigskip` Slightly bigger than `\bigskip`

`\newslide` finishes the current slide and prepares for the next. The last slide is finished with the `\bye` command.

`\mm` `\pt` `\in` Use these for dimensions instead of mm, pt, in. The reason is rather technical and has to do with the magnification. Do not use "true pt" etc because then `\style fourslides` (below) will not work.

`\style fourslides`

For documentation of slides. Puts four reduced-size slides on one page. The same subcommands as `\style slides`.

`\style afivemag`

This format is intended for documents that are to be printed on an A4 paper, but later photographically reduced to A5 format. By default the output is in the reduced format.

`\finalversion` Turns on the magnification. Also removes the date and index information and moves the page number to the left on even-numbered pages.

`\style problems`

This format was designed for problem collections, exams etc. It allows both the problems and the solutions to be kept in the same file and printed either together or only the problems or only the solutions.

`\problem` marks the start of a problem or of a problem-solution pair. It is automatically numbered.

`\solution` marks the start of the solution part. This part is optional.

`\endproblem` the end of a problem or a problem-solution pair.

`\subproblem b` marks a subproblem with the parameter letter (`b` in this case). It may be used both in the problem part and in the solution part.

`\problemonly` Only the problem part of the problem-solution pairs are printed from now on.

`\solutiononly` Only the solution part of the problem-solution pairs are printed from now on.

16. Miscellaneous Commands

This section contains some commands, and some comments, that did not fit anywhere else. Some of them are simple, some quite advanced.

`\\` Breaks the line. In section 4, "Chapters and Sections" was mentioned that a heading may be broken with `\\`. This is in fact general and applies to any line, although the exact function may be slightly different in different contexts.

`\note{Any text}` The parameter text will be put in the right margin except in `\finalversion`.

`\square{3mm}` Gives a square with the specified dimension.

`\endsquare` Gives a right-adjusted square that is used for example to finish a theorem or an example. See the examples part.

In some cases it is desirable to initialize page number, section number etc to a number other than 1. The page number is set with the command `\pageno=4`. The other numbers that may be set are: `\sectionno`, `\subsectno`, `\figureno`, `\tableno`, `\listno`, `\equationno`, `\lemmano`, `\theoremno`, `\exampleno`, `\definitionno`, `\resultno`, `\problemno`. To set the chapter number without using a full chapter heading, write `\def \ch{4}`.

17. Writing Style Files

This section is not intended for beginners. It describes the commands that are used in the various style files and that are not part of Plain T_EX. A style file must have a name ending in `.sty` and may be placed anywhere in the T_EX input path. For examples, see the standard style files.

Setting Fonts

Apart from the font commands already mentioned in section 9 there are some commands to set the main font for an entire document.

`\mainfontviiipt` `\mainfontixpt` `\mainfontxpt` `\mainfontxipt` Sets the main font size to 8 point, 9 point, 10 point and 11 point respectively. In each case the various section headings, the caption font size and the footnote font size are also changed to fit the main font size.

`\sectionfont` `\subsectfont` `\subsubsectfont` `\chapterfont` These are automatically called within the `\section`, `\subsect` etc. commands to specify the font of the heading. They should therefore be complete font specifications. Example: if the main font size is 10 pt then `\sectionfont` is defined as `\def \sectionfont{\xipt \bf}`

`\authorfont` This command is called when processing references, and should be defined to specify a suitable font for the author name. The default definition is `\let \authorfont=\csc`.

`\captionsize` `\footnotesize` Called automatically when processing figure captions and footnotes respectively. The default definitions when the main font is 10 pt are `\let \captionsize=\viiipt` and `\let \footnotesize=\viiipt` respectively.

Headlines and Footlines

The commands `\oddheadline`, `\oddfootline`, `\evenheadline`, `\evenfootline` are used by the output routine to get the respective headline and footline. The call is made with `\line{\oddheadline}` etc for the various versions. The commands should therefore be defined so that they specify a complete line, i.e., they should contain at least one `\hfil` command. Useful subcommands are:

`\mainfont` Sets the font to whatever was specified in the `\mainfont..pt` command. This is necessary in the headline/footline definition, since \TeX may have any font as the current font when the output routine is entered.

`\date` Today's date in ISO format, i. e. 1989-04-29.

`\datetime` Today's date and time in the form 1989-04-29 13:53.

`\qdate` Like `\datetime` but is redefined to nothing by `\finalversion`

`\topmark` See the discussion in the \TeX book.

`\folio` The page number.

Example: `\style report` contains the definition

```
\def \oddfootline{\mainfont \qdate \hfil \folio}
```

`\toprule \notoprule` Enables and disables a rule below the pagehead.

Magnification

`\setmagnification{1440}` Defines a new counter, `\magnification`, to have the value specified. Also defines the dimen parameters `\pt`, `\in`, `\mm` as described in `\style slides`. The actual magnification is turned on with the command `\mag=\magnification`. In some of the formats, for example `\style afivemag`, this is part of the `\finalversion` command.

18. Examples

The following pages contain some examples with the source text to the left and the result to the right. In some cases the source text contains comments which may be of interest.

This page contains only this sentence.


```

\style report
\verb @
\chapter 3 {Differential Equations}
Solution of ordinary nonlinear differential equations is a
simple application of Simnon. In such applications Simnon
can be viewed simply as a calculator for differential
equations. There are two minor differences compared to a
calculator. Simnon can display curves. In a calculator
a function is activated by pushing a dedicated key.
In Simnon functions are activated by typing a command on
the keyboard.
%-----
\section{The Problem}
Suppose that we would like to know the character of the
solution to the van der Pol equation

$$\frac{d^2y}{dt^2} + a(y^2-b) \frac{dy}{dt} + y = 0$$

\eqno $$
for different initial conditions and different values of
the parameters $a$ and $b$. The van der Pol equation is a
model for an electronic oscillator.
The solution can be divided in the following steps.
\itemmarg=1em % Suitable for \bullet items.
\bullet Enter system descriptions
\bullet Simulate
\bullet Analyze the results
\bullet Change parameters and initial conditions
\itemskip
%
where the last three steps are iterated until a
satisfactory result is obtained. The different steps will
now be described in some detail.
%-----
\section{Enter the System Description}
The equation \lasteq\ is first rewritten as a system of first
order differential equations \nexteq\ and \nexteq'$.
Since the equation \lasteq\ is of second order an extra variable
has to be introduced. Choosing this variable as
 $x = \frac{dy}{dt}$  the equation \lasteq\ can be written as

$$\begin{aligned} \frac{dy}{dt} &= x & \text{\eqno \label{vdpol} \cr} \\ \frac{dx}{dt} &= ax(b-y^2)-y & \text{\eqno (\lasteq')} \end{aligned}$$

\eqno (\lasteq')
The command @SIMU 0 20 - MARK@ activates a simulation and
the result shown in Fig.~\nextfig\ is obtained.
%
\topinsert
\vglue 30mm
\figure{Simulation of the van der Pol equation for $a=1$
and $b=1$ with initial values $x(0)=1$ and $y(0)=0$}
\endinsert
%
```

3. Differential Equations

Solution of ordinary nonlinear differential equations is a simple application of Simnon. In such applications Simnon can be viewed simply as a calculator for differential equations. There are two minor differences compared to a calculator. Simnon can display curves. In a calculator a function is activated by pushing a dedicated key. In Simnon functions are activated by typing a command on the keyboard.

3.1 The Problem

Suppose that we would like to know the character of the solution to the van der Pol equation

$$\frac{d^2y}{dt^2} + a(y^2 - b)\frac{dy}{dt} + y = 0 \quad (3.1)$$

for different initial conditions and different values of the parameters a and b . The van der Pol equation is a model for an electronic oscillator. The solution can be divided in the following steps.

- Enter system descriptions
- Simulate
- Analyze the results
- Change parameters and initial conditions

where the last three steps are iterated until a satisfactory result is obtained. The different steps will now be described in some detail.

3.2 Enter the System Description

The equation 3.1 is first rewritten as a system of first order differential equations 3.2 and 3.2'. Since the equation 3.1 is of second order an extra variable has to be introduced. Choosing this variable as $x = \frac{dy}{dt}$ the equation 3.1 can be written as

$$\frac{dy}{dt} = x \quad (3.2)$$

$$\frac{dx}{dt} = ax(b - y^2) - y \quad (3.2')$$

The command `SIMU 0 20 - MARK` activates a simulation and the result shown in Fig. 3.1 is obtained.

Figure 3.1 Simulation of the van der Pol equation for $a = 1$ and $b = 1$ with initial values $x(0) = 1$ and $y(0) = 0$.

```

\par
A file which describes the system should now be prepared.
This file named @vdpol@ is listed in Listing~\nextlist.
The first line indicates that it is a continuous time
system with the name @vdpol@. The state variables $x$ and
$y$ and their derivatives, which are called $dx$ and $dy$,
are declared. The differential equations are then defined.
Notice the strong similarity with equation \lasteq.
\topinsert
\verbatiminput vdpol.t
\medskip
\listing{A Simmon system for Equation \xref{vdpol}.}
\endinsert
%
\section{Expressions and operators}
The expressions available in Simmon are similar to those
in a procedural language like Algol or Pascal.
An expression may be a numeric constant or a variable.
It may also be combinations of variables, operators and
functions.
%
\subsection{Relational operators}
\smallskip
\settabs\+EQ\quad&greater than or equal\quad&EQ\quad&\cr
\+EQ &equal &LE &less than or equal \cr
\+GE &greater than or equal &LT &less than \cr
\+GT &greater than &NE &not equal \cr
%
\subsection{Functions}
The standard mathematical functions are available. The
details are given in the reference section.
%
\section{Examples}
An important question is ‘‘Do the problems with indices
greater than one arise ‘naturally’?’’. The answer to the
question is undoubtedly yes. Let us consider some examples.
%
\example{Rotating Masses}
A model for two rotating masses which are connected rigidly
to each other is given by $(a,b,c)$ and
$$ \omega_1 = \omega_2 $$
It is easy to realize that the BLT-partition procedure
described above will fail if it is applied on the problem.
\endsquare
%
% omission
%
%
\endchapter

```

```

CONTINUOUS SYSTEM vdpol
"The van der Pol equation
STATE x y
DER dx dy
dy=x
dx=a*x*(b-y*y)-y
a:1
b:1
END

```

Listing 3.1 A Simmon system for Equation 3.2.

A file which describes the system should now be prepared. This file named `vdpol` is listed in Listing 3.1. The first line indicates that it is a continuous time system with the name `vdpol`. The state variables x and y and their derivatives, which are called dx and dy , are declared. The differential equations are then defined. Notice the strong similarity with equation 3.2.

3.3 Expressions and operators

The expressions available in Simmon are similar to those in a procedural language like Algol or Pascal. An expression may be a numeric constant or a variable. It may also be combinations of variables, operators and functions.

Relational operators

| | | | |
|----|-----------------------|----|--------------------|
| EQ | equal | LE | less than or equal |
| GE | greater than or equal | LT | less than |
| GT | greater than | NE | not equal |

Functions

The standard mathematical functions are available. The details are given in the reference section.

3.4 Examples

An important question is "Do the problems with indices greater than one arise 'naturally'?" The answer to the question is undoubtedly yes. Let us consider some examples.

EXAMPLE 3.1—Rotating Masses

A model for two rotating masses which are connected rigidly to each other is given by (a, b, c) and

$$\omega_1 = \omega_2$$

It is easy to realize that the BLT-partition procedure described above will fail if it is applied on the problem. \square

\style letter

\address

H. J. Murray, Esq.
British Plastics Co. Ltd.
26, Ellesmere Road
Preston Lancs.
England.

%

\body

Dear Mr Murray,

It was very kind of you indeed to look after me so well at the International Plastics Convention in London, recently. I very much appreciated all the trouble you took not only during the daytime, but also in the evenings, when you entertained myself and my wife so magnificently. As you so rightly said, it is only people from Lancashire who know London well, and you certainly showed us a great many things in London that I had never seen before.

You also helped me greatly at the Convention itself by introducing me to your associates and to your friends and acquaintances from other countries. It was a great pleasure to meet them and to exchange ideas with them. I cannot thank you enough for everything you did to make the Convention worthwhile, and I hope that I shall very shortly have the opportunity of repaying the hospitality which you so generously gave to my wife and myself.

%

\closing

Yours sincerely,
Axel Gustafsson

%

\ps

Please also convey my thanks to your colleague Mr Jones.

\cc Erik Nilsson, Charles Wilkinson

%

\endletter

\bye

1989-06-06

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Yours sincerely,

Axel Gustafsson

PS: Please also convey my thanks to your colleague Mr Jones.

cc: Erik Nilsson, Charles Wilkinson

```

\references          % Please note the order between
\chapter {5} {References} % \chapter and \references
\bref \AA str"om,~K.~J. \and B.~Wittenmark \year 1989
\book Adaptive Control
\publ Addison-Wesley \publaddr Reading, Mass
\endref
\bref Dahl,~O. \year 1985
\report Image processing techniques for ash line detection
\reportinfo Master thesis CODEN: LUTFD2/TFRT-5328
\publ Department of Automatic Control, Lund Institute of
Technology
\publaddr Lund, Sweden
\endref
\bref Dahl,~O. \and L.~Nielsen \year 1986
\paper Ash-line control
\book First IFAC Workshop on Vision Control
\publaddr Espoo, Finland
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\publ Addison-Wesley \publaddr Reading, Mass
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and Industrial Applications
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\bref Schlegel, S. \year 1985
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\book Instrumentation and Control of Water and Wastewater
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Pollution Control
\inref R. A. R. Drake \ed
\publ IAWPRC, Pergamon Press \pages 391--396
\endref
\bref Silverberg,~P., L.~Nielsen, P.~Omling, \and
L.~Samuelsson \year 1985
\paper EL2-maps from computer based image analysis
of semi-insulating GaAs wafers
\book Symposium on Defect Recognition and Image
Processing in III-V Compounds
\publaddr Montpellier, France
\endref
\endreferences
\endchapter

```

5. References

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- DAHL, O. (1985): "Image processing techniques for ash line detection," Master thesis CODEN: LUTFD2/TFRT-5328, Department of Automatic Control, Lund Institute of Technology, Lund, Sweden.
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```
% This is an example of the use of \style slides.  
% The same text will be found as part of the example  
% of \style fourslides on the following pages.  
%
```

```
\style slides  
\centerhead{Choice of Prefilter}  
Simplification gives illumination
```

```
Process
```

```
%  
$$ A_0(q)y(t) = B_0(q)u(t) $$  
%
```

```
Use Least Squares estimation
```

```
%  
$$ R(q)u(t) = -S(q)y(t) + T(q)u_c(t) $$  
%
```

```
Assume that the controller is chosen such that
```

```
$$G_c(q) = B_m(q)/A_m(q)$$
```

```
%-----  
\bye
```

Choice of Prefilter

Simplification gives illumination

Process

$$A_0(q)y(t) = B_0(q)u(t)$$

Use Least Squares estimation

$$R(q)u(t) = -S(q)y(t) + T(q)u_c(t)$$

Assume that the controller is chosen such that

$$G_c(q) = B_m(q)/A_m(q)$$

```

\style fourslides
%-----
\centerhead{Slides with \TeX}
\centerline{Leif Andersson}
\centerline{Lund Institute of Technology}
\Bigskip
\bullet Modelling
\bullet Choice of prefilter
\bullet Today and Tomorrow
\newslide
%-----
\centerhead {Modelling}
A control system is regarded as a hierarchy of components.
Different degrees of detail and complexity.
Standard model libraries needed.

Models are described by
\bullet Equations at the lowest level.
\bullet Block diagrams at higher levels.
%-----
\newslide
\centerhead{Choice of Prefilter}
Simplification gives illumination

Process
%
$$ A_0(q)y(t) = B_0(q)u(t) $$
%

Use Least Squares estimation
%
$$ R(q)u(t) = - S(q)y(t) + T(q)u_c(t) $$
%
Assume that the controller is chosen such that
$$G_c(q) = B_m(q)/A_m(q)$$
%-----
\newslide
\leftthead{Today}
Today's simulation packages solve
$$\dot{x} = f(t,x), \quad x(t_0)=x_0.$$
The user must define a procedure\hfill\break
to calculate the derivatives, i.e. $f(t,x)$.
\Bigskip
\leftthead{Tomorrow}
The natural notation is equations:
$$g(t, \dot{x}, x) = 0$$
\bye

```

Slides with T_EX

Leif Andersson
Lund Institute of Technology

- Modelling
- Choice of prefilter
- Today and Tomorrow

Modelling

A control system is regarded as a hierarchy of components. Different degrees of detail and complexity. Standard model libraries needed.

Models are described by

- Equations at the lowest level.
- Block diagrams at higher levels.

Choice of Prefilter

Simplification gives illumination

Process

$$A_0(q)y(t) = B_0(q)u(t)$$

Use Least Squares estimation

$$R(q)u(t) = -S(q)y(t) + T(q)u_c(t)$$

Assume that the controller is chosen such that

$$G_c(q) = B_m(q)/A_m(q)$$

Today

Today's simulation packages solve

$$\dot{x} = f(t, x), \quad x(t_0) = x_0.$$

The user must define a procedure to calculate the derivatives, i.e. $f(t, x)$.

Tomorrow

The natural notation is equations:

$$g(t, \dot{x}, x) = 0$$

