

Package `paracol`: Yet Another Multi-Column Package to Typeset Columns in *Parallel*

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version 1.1: 2012/05/11

Abstract

This package provides a L^AT_EX environment named `paracol` in which you may *switch* and *synchronize* columns by a command `\switchcolumn` and by internal environments `column`, `nthcolumn`, `leftcolumn` and `rightcolumn`.

1 Introduction

This document describes the usage of yet another multi-column package named `paracol`. The unique feature of the package is that columns are typeset *in parallel*.

Suppose you are writing a bilingual document whose left column is written in a language, say English, and right column has the translation of the left column in another language, e.g. Japanese. With the `paracol` package you may write an English part of arbitrary length and then *switch* to its Japanese counterpart to place both parts side by side. Of course you may return to the English writing similarly.

The *column-switching* is always allowed when you complete an outermost level paragraph. You may be unaware whether a column is broken into multiple pages before switching because the package automatically goes back and forward to the correct page and vertical position when you switch the column. Moreover, you may *synchronize* columns so that the tops of the first paragraphs after switching in all columns are vertically aligned. At a synchronization point, you may give a single-column text, for example a common section header, optionally. You may also switch single-column and multi-column in a page arbitrary.

This manual itself is an example of two-column

```
\begin{paracol}{2}[\section{Introduction}]
\hbadness5000
```

This document describes the usage of yet another multi-column package named `\textsf{paracol}`. The unique feature of the package is that columns are typeset *{em in parallel.}*

Suppose you are writing a bilingual document whose left column is written in a language, say English, and right column has the translation of the left column in another language, e.g. Japanese. With the `\textsf{paracol}` package you may write an English part of arbitrary length and then *{em switch}* to its Japanese counterpart to place both parts side by side. Of course you may return to the English writing similarly.

The column switching is always allowed when you complete an outermost level paragraph. You may be unaware whether a column is broken into multiple pages before switching because the package automatically goes back and forward to the correct page and

documents typeset by `paracol`. Since the author is not familiar with languages other than English and Japanese and the latter should be hardly understood by most of readers, the right column is the translation of the left English column into a computational language. That is, the right column is the \LaTeX source code of the left column¹.

vertical position when you switch the column. Moreover, you may `\em synchronize` columns so that the tops of the first paragraphs after switching in all columns are vertically aligned. At a synchronization point, you may give a single-column text, for example a common section header, optionally. You may also switch single-column and multi-column in a page arbitrary.

This manual itself is an example of two-column documents typeset by `\textsf{paracol}`. Since the author is not familiar with languages other than English and Japanese and the latter should be hardly understood by most of readers, the right column is the translation of the left English column into a computational language. That is, the right column is the \LaTeX source code of the left column%
`\footnote{Not really but its essence is shown.}`.

`\switchcolumn`

`\begin{verbatim}`
Here is the source of above.
`\end{verbatim}`¹

2 Basic Usage

Loading the package is very simple. What you have to do is `\usepackage{paracol}` in the preamble. Note that `paracol` can be used with \LaTeX 2_ε and does not work with \LaTeX 2.09.

The fundamental means of parallel-column typesetting are the environment `paracol` and the command `\switchcolumn`. The `paracol` environment needs an argument to specify the number of columns. Thus the following is the basic construct for two-parallel-column documents.

```
\begin{paracol}{2}
left column text
\switchcolumn
```

¹Not really but its essence is shown.

```
\switchcolumn*[\section{Basic Usage}]
Loading the package is very simple. What
you have to do is |\usepackage{paracol}|
in the preamble. ...2
\switchcolumn
source
\switchcolumn*
The fundamental means of parallel-column
typesetting are the environment |paracol|
and the command |\switchcolumn|. ...
\switchcolumn
source
```

¹This `verbatim` construct is simply referred as to “*source*” hereafter.

²Hereafter, a part of the source code may be omitted like this.

```

right column text
\switchcolumn
left column text
\switchcolumn
right column text
\switchcolumn
:
\end{paracol}

```

The `\switchcolumn` command may have an optional argument to specify the column number (zero origin) to start. That is, `\switchcolumn[0]` means to switch to the leftmost column, `\switchcolumn[1]` is to start the second column and so on. Thus the `\switchcolumn` without the optional argument may be considered as `\switchcolumn[i+1 mod n]` where i is the last column number and n is the number of columns given to `paracol` environment.

3 Column Synchronization

The `\switchcolumn` command may also be followed by a ‘*’ to *synchronize* columns. After you switch from a column to another by `\switchcolumn*` (or `\switchcolumn[i]*`), all the columns are vertically aligned at the bottom of the *deepest* one preceding the command. For example, the previous section has three `\switchcolumn*` commands at which left and right columns are vertically aligned.

The *starred* version of `\switchcolumn` may have an optional argument to specify a *multi-column text* whose bottom is the vertical alignment points of the columns. For example, `\section` commands in this manual are given as optional arguments of `\switchcolumn*` like;

```
\switchcolumn*[\section{Basic Usage}]
```

The `paracol` environment may also start with a multi-column text by specifying it as the optional argument of `\begin{paracol}`. For example, at the beginning of this document, the author put;

```
\begin{paracol}{2}[\section{Introduction}]
```

4 Environments for Columns

4.1 Environment column

The `\switchcolumn` is simple but you may prefer to pack the contents of a column in an environment. The `column` environment is available for

```

\switchcolumn[1]*
source
\switchcolumn[0]

```

The `|\switchcolumn|` command may have an optional argument to specify the column number (zero origin) to start. ...

```

\switchcolumn[0]*[%
\section{Column Synchronization}
\label{sec:sync}]

```

The `|\switchcolumn|` command may also be followed by a ‘|*|’ to `{\em synchronize}` columns. ...

The `{\em starred}` version of `|\switchcolumn|` may have an optional argument to specify a multi-column text whose bottom is the vertical alignment points of the columns. ...

```

\switchcolumn
source

```

4.1 Environment column

```

\begin{column*}[%
\section{Environments for Columns}
\label{sec:env}]

```

this well-structurization of L^AT_EX sources for parallel columned documents. A construct;

```
\begin{column}
  text for a column
\end{column}
```

is (almost) equivalent to;

```
\switchcolumn
  text for a column
```

The `column*` environment is also available for the column synchronization and may have an optional argument for multi-column text.

4.2 Environment `nthcolumn`

The `\switchcolumn` can start an arbitrarily specified column with the column number given through its optional argument, but the `column` environment cannot do it. If you want to start *i*-th column, you have to do `\begin{nthcolumn}{i}` (or `nthcolumn*` with an optional argument to synchronize).

4.3 Environment `leftcolumn` and `rightcolumn`

The environment `leftcolumn` and `rightcolumn` (and their starred versions with an optional argument) are available as more convenient means than saying `\begin{nthcolumn}{0}` and `\begin{nthcolumn}{1}`.

```
\subsection{Environment \texttt{column}}
The |\switchcolumn| is simple but you may
prefer to pack the contents of a column in
an environment. ...
\end{column*}
\begin{column}
  source
\end{column}
```

4.2 Environment `nthcolumn`

```
\begin{nthcolumn*}{1}
  source
\end{nthcolumn*}

\begin{nthcolumn}{0}
\subsection{Environment \texttt{nthcolumn}}
The |\switchcolumn| can start an
arbitrarily specified column with the
column number given through its optional
argument, but the |column| environment
cannot do it. ...
\end{nthcolumn}
```

4.3 Environment `leftcolumn` and `rightcolumn`

```
\begin{leftcolumn*}
\subsection{%
  Environment \texttt{leftcolumn} and\
  \texttt{rightcolumn}}
The environment |leftcolumn| and
|rightcolumn| (and their starred versions
with an optional argument) are available as
more convenient means than saying
|\begin{nthcolumn}{0}| and
|\begin{nthcolumn}{1}|.
\begin{figure*}...\end{figure*}
\begin{figure}[t]...\end{figure}
\end{leftcolumn*}
\begin{rightcolumn}
  source and a figure env
\end{rightcolumn}
```



Figure 1: A Double-Column Figure

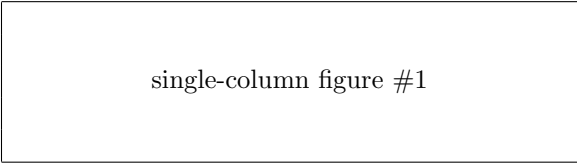


Figure 2: A Single-Column Figure

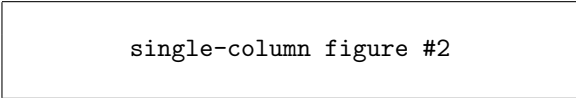


Figure 3: Another Single-Column Figure

5 Floats, Footnotes and Counters

5.1 Figures and Tables

As shown in this page, double-column figures/tables (or those spanned multiple columns if you have three or more) may be placed by `figure*` and `table*` environments as usual. A single-column figure/table will be placed in the column in which you put `figure` and `table`. For example, the contents of `figure` environment in a `leftcolumn` environment is *always* placed in a left column. That is, even if the column of the *current* page does not have enough room to place the figure, it will not thrown to the right column but will be placed in the left column of the next page².

Another caution about float placement is that you have to be careful when you try to put a top-float explicitly with `t`-option or implicitly without placement option (i.e., `tbp` in most classes) and to synchronize columns. The rule is as follows; after you synchronize columns in a page, the page cannot have top-floats any more. When you synchronize columns, `paracol` fixes a virtual horizontal line in the page as the synchronization barrier. Thus no top-floats cannot be added above the line³. Therefore, the au-

5.1 Figures and Tables

```
\begin{leftcolumn*}[\section{%
  Floats, Footnotes and Counters}]
\begin{table}[b]\nosv
\caption{A Single-Column Table}
\centerline{\begin{tabular}[t]{|l|c|r|}
\hline
An&example&of\\\hline
single&column&table\\\hline
\end{tabular}}
\end{table}
\subsection{Figures and Tables}
As shown in this page, double-column
figures\slash tables (or those spanned
multiple columns if you have three or more
columns) may be placed by |figure*| and
table* environments as usual3. ...
```

5.2 Footnotes and Marginal Notes

Footnotes are also put at the bottom of the column in which `|\footnote|` commands and their references (like this`\footnote{%`

Table 1: A Single-Column Table

An	example	of
single	column	table

²Or some farther page if `LATEX` cannot solve the placement problem wisely.

³Even if you have enough space above, sorry.

Table 2: Another Single-Column Table

Another	example
of	single
column	table

³Another example of footnote.

thor put two `figure` environments for the figures shown in the previous page into the `leftcolumn*` and `rightcolumn` environment for the previous section.

5.2 Footnotes and Marginal Notes

Footnotes are also put at the bottom of the column in which `\footnote` commands and their references (like this⁴) reside, as shown in page 2 and this page. Marginal notes behave similarly like what you are seeing in the left margin of this sentence and the right marginal note in this page⁵.

5.3 Local and Global Counters

You probably found that the numbering of figures and tables is *global* while that of footnotes are *local*. That is, the figure in the right column of the previous page has number 3 following its left-column counterpart Figure 2. The tables in the page are also numbered as 1 and 2 crossing the column boundary. However, the footnotes in each column have their own numbering sequence. Moreover, the footnote numbers in left columns are typeset in Roman font while those in right columns have italic shapes. Similarly, sub-section numbering is local and the headings in right columns have typewriter-face numbers.

This happens because the author declared the counters `figure` and `table` are *global* in the preamble of this document by saying;

```
\globalcounter{figure}
\globalcounter{table}
```

and do nothing about `footnote` and `subsection` counters. By default, all the counters except for `page` are local to columns. The value of a local counter of a column is saved somewhere when you leave the column, and it is restored when you revisit the column. The initial value of the local counters are the value they have at `\begin{paracol}`. After you close the `paracol` environment, the values of the left-most column are used for the rest of your document until you start new `paracol` environment. On a restart,

⁴An example of footnote.

⁵If you have three or more columns, marginal notes of the second or succeeding columns are placed just right of the column. Thus marginal notes of non-leftmost and non-rightmost columns will appear in the space separating columns rather than the margin of a page.

another figure with [t] option
to fill space

Figure 4: Another Figure with [t] Option

An example of footnote.}) reside, as shown in page~2 and this page. Marginal notes behave similarly like what you are seeing in the left margin of this sentence\marginpar{\raggedright An example of marginal note.} and the right marginal note in this page\footnote{...}. ...

5.3 Local and Global Counters

You probably found that the numbering of figures and tables is `\emph{global}` while that of footnotes are `\emph{local}`. ...

`\end{leftcolumn*}`

source.

Another
example
of
marginal
note.

a figure with [b] option
to fill space

Figure 5: A Figure with [b] Option

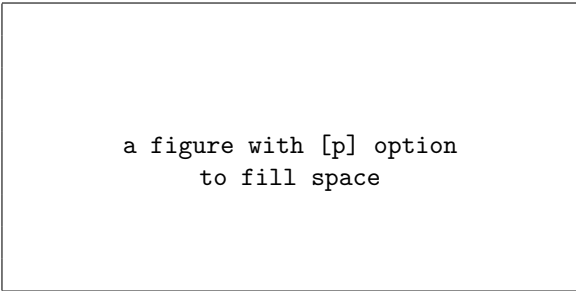
local counters in a column have the values they had at the last `\end{paracol}`, except for those which have been modified outside the environment because the modifications are *broadcasted* to local counters in all columns. You will see the effect of this inter-environment counter value conservation in the footnote numbers in the right column in page 5 and 9.

This broadcasting of a local counter value can be done explicitly in `paracol` environment by a command `\synccounter{ctr}`. This command makes *ctr* in all columns have the value of that in the column in which the command appears. In addition, another command `\syncallcounters` performs this broadcasting for all local counters.

If you make a counter global by the command `\globalcounter`, the save/restore operations are not performed to the counter and thus it is globally incremented by `\[ref]stepcounter` or commands such as `\caption` and `\section`. Note that the value of a global counter depends on the place where it is incremented (or set) in the *source code* rather than where it appears in the output. Thus if the author put a `table` environment here to increment `table` counter, the right-column table at the bottom of page 5 would be Table 3 because its `table` environment does not appear yet in the source code. Note that, however, though the counter `page` is global as expected, its numbering is consistent among all columns as far as you refer to the value by `\pageref{label}` and/or see the values in table of contents, etc.

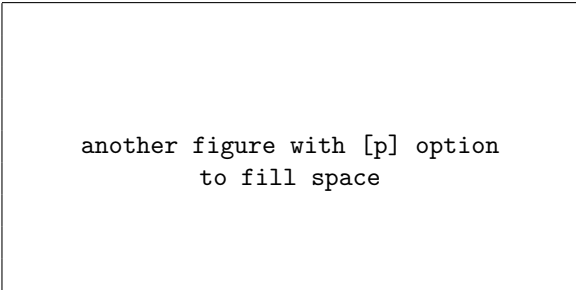
Another counter which the author made global in this document is `section`. As explained in Section 3, an optional multi-column text of column-switching is considered as in the left-most column. Since `\section` commands in this document are always multi-column texts, so far, it seems unnecessary to make `section` global because it is incremented correctly in the left-most column. However, the stepping `section` has a side effect to reset its decendent counter `subsection` and referred from `\thesubsection` command. Thus if `section` were local, the right-column sub-sections in Section 4 would be numbered as “0.1”, “0.2” and “0.3” because the local value of `section` would be zero. Moreover, the right-column sub-sections of this section would be “0.4”, “0.5” and “0.6” because stepping `section` local to left-columns would not reset `subsection` local to right-columns.

You may give a local appearance to a counter *ctr* for the *i*-th column (zero origin) by a command;



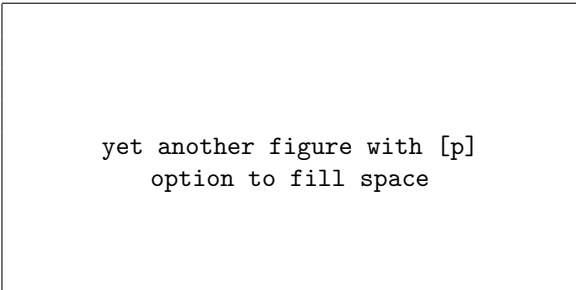
a figure with [p] option
to fill space

Figure 6: A Figure with [p] Option



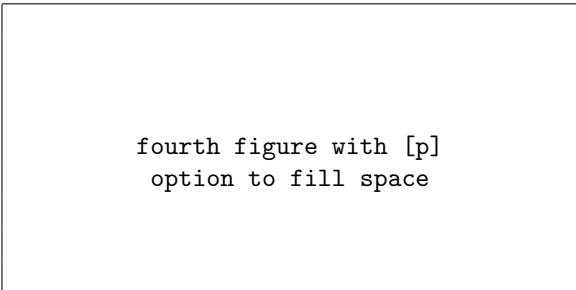
another figure with [p] option
to fill space

Figure 7: Another Figure with [p] Option



yet another figure with [p]
option to fill space

Figure 8: Yet Another Figure with [p] Option



fourth figure with [p]
option to fill space

Figure 9: Forth Figure with [p] Option

```
\definethecounter{ctr}{i}{def}
```

where *def* is to be the body of the local definition of `\thectr`. For example, the preamble of this document has the following to give non-default definitions to `\thefootnote` and `\thesubsection` for right columns.

```
\definethecounter{footnote}{1}{%
  \textit{\arabic{footnote}}}
\definethecounter{subsection}{1}{%
  \texttt{%
    \arabic{section}.\arabic{subsection}}}
```

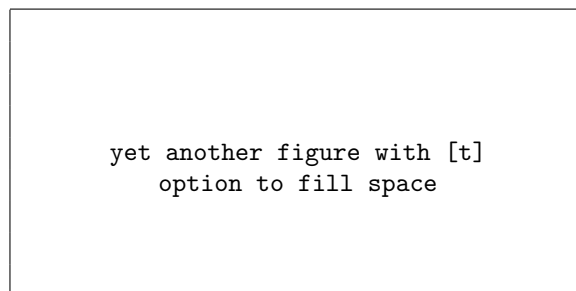


Figure 10: Yet Another Figure with [t] Option

6 Closing paracol Environment and Page Flushing

The final example shown here is this single-column text which the author put after `paracol` environment is closed. As you are seeing, `paracol` environment can be finished at any vertical position in a page and can be followed by ordinary single column texts.

The environment may also be restarted anywhere you like as shown here.

The last issue is to flush a page. The ordinary `\newpage` command works as you expect. If you say `\newpage` in the left column in a page, the contents following it will appear in the left column in the next page. Note that this does not affect the layout of the right column.

To flush all columns in a page, a command `\flushpage` is available. This command in *i*-th column is almost equivalent to;

```
\switchcolumn[i]*[\newpage]
```

but more robust⁶. The ordinary page breaking command `\clearpage` may also be used to flush all columns and to start a fresh page, but it has a side effect to put all figures and tables which are not yet output.

Now the author will do `\flushpage` shortly to start a real binlingual example from the next page, after showing another example of closing `paracol` environment in this sentence and of restarting in the next one, in which *unbalanced column width* is demonstrated using `\columnratio` command shown in Section 7.3.

O.K., we have restarted `paracol` environment and we will see the effect of `\flushpage` now!!

```
\begin{leftcolumn}
The environment may also be restarted
anywhere you like as shown here. ...
\end{leftcolumn}
source
\end{paracol}
Now the author will do ...
```

```
\columnratio{0.6}
\begin{paracol}{2}
\begin{leftcolumn}
O.K., we have restarted |paracol|
environment and we will see the
effect of |\flushpage| now!!
\end{leftcolumn}
source
```

⁶For example `\switchcolumn*` may flush a page for the synchronization and thus `\newpage` may leave an empty page.

An Die Freude/To Joy

Friedrich Schiller

The following is the libretto of the fourth movement of Beethoven's Ninth Symphony, his adaptation of Schiller's ode "An Die Freude" (or "To Joy" in English). Beethoven's additions and revisions are indicated in italics.

O Freunde, nicht diese Töne!
Sondern laßt uns angenehmere anstimmen und freudenvollere⁷.

Oh friends, no more of these sad tones!
Let us rather raise our voices together
In more pleasant and joyful tones⁴.

Freude!
Freude, schöner Götterfunken Tochter aus Elysium,
Wir betreten feuertrunken, Himmelsche, dein Heiligtum!
Deine Zauber binden wieder, *Was die Mode streng geteilt;*
Alle Menschen werden Brüder⁸, Wo dein sanfter Flügel weilt

Joy!
Joy, thou shining spark of God,
Daughter of Elysium,
With fiery rapture, goddess,
We approach thy shrine.
Your magic reunites
That which stern custom has parted;
All humans will become brothers⁵
Under your protective wing.

Wem der große Wurf gelungen, eines Freundes Freund zu sein;
Wer ein holdes Weib errungen, mische seinen Jubel ein!
Ja, wer auch nur eine Seele sein nennt auf dem Erdenrund!
Und wer's nie gekonnt, der stehle weinend sich aus diesem
Bund!

Let the man who has had the fortune
To be a helper to his friend,
And the man who has won a noble woman,
Join in our chorus of jubilation!
Yes, even if he holds but one soul
As his own in all the world!
But let the man who knows nothing of this
Steal away alone and in sorrow.

Freude trinken alle Wesen an den Brüsten der Natur;
Alle Guten, all Bösen folgen ihrer Rosenspur.
Küsse gab sie uns und Reben, einen Freund, geprüft im Tod;
Wollust ward dem Wurm gegeben, und der Cherub steht vor
Gott.

All the world's creatures drink
From the breasts of nature;
Both the good and the evil
Follow her trail of roses.
She gave us kisses and wine
And a friend loyal unto death;
She gave the joy of life to the lowliest,
And to the angels who dwell with God.

Froh, wie seine Sonnen fliegen durch des Himmels prächt'gen
Plan,
Laufet, Brüder, eure Bahn, freudig, wie ein Held zum Siegen.

Joyous, as his suns speed
Through the glorious order of Heaven,
Hasten, brothers, on your way,
Joyful as a hero to victory.

Seid umschlungen, Millionen! Diesen Kuß der ganzen Welt!

Be embraced, all ye millions!
With a kiss for all the world!

⁷If I had been a good student in my German class, this footnote would say "This part was added by Beethoven." in German.

⁸Original: Was der Mode Schwert geteilt;
Bettler werden Fürstenbrüder,

⁴This part was added by Beethoven.

⁵Original: What custom's sword has parted;
Beggars become princes' brothers

Brüder, über'm Sternenzelt muß ein lieber Vater wohnen.

Ihr stürzt nieder, Millionen? Ahnest du den Schöpfer, Welt?
Such'ihn überm Sternenzelt! Über Sternen muß er wohnen.

Brothers, beyond the stars
Surely dwells a loving Father.

Do you kneel before him, oh millions?
Do you sense the Creator's presence?
Seek him beyond the stars!
He must dwell beyond the stars.

7 Reference Manual

7.1 Environment `paracol`

`\begin{paracol}{num}[text] body \end{paracol}`

The environment `paracol` contains *body* typeset in *num* columns in parallel. The optional *text* is put spanning all columns prior to the multi-columned *body*.

- The environment may start from *any* vertical position in a page, i.e., not necessary at the top of a page. The single-column contents of the *starting page* in which `\begin{paracol}` lies are naturally connected to the beginning part of *body* in each column, unless the page has footnotes or bottom floats. If these kind of bottom stuff exist, they are put above the multi-columned *body*, or the multi-column *text* if provided. The *deferred* floats which have not yet appeared in the starting page and thus will appear in the next or succeeding pages are considered as multi-column floats given in the environment.
- All local counters in all columns are initialized to have the values at `\begin{paracol}` on its first occurrence. On the second and succeeding occurrences of `\begin{paracol}`, the local counters in each column have the value at the last `\end{paracol}`, unless they are modified after the `\end{paracol}`. If a counter is modified (or declared by `\newcounter`) after the `\end{paracol}`, the local versions of the counter in all column commonly have the value at `\begin{paracol}`.
- The environment may end at *any* vertical position in a page, i.e., the *post-environment stuff* being the single-column texts and others following `\end{paracol}` may not start from the top of a page. If any columns don't have deferred single-column floats and the most advanced *leading column* at `\end{paracol}` has neither of footnotes nor bottom floats, its bottom is naturally connected to the post-environment stuff. If the leading column has these kinds of bottom stuff, they are put above the post-environment stuff, with a vertical skip of `\textfloatsep` separating them if bottom floats exist. All deferred single-column floats given in the environment are flushed before the post-environment stuff appears, possibly creating *float columns* only with floats. On the other hand, deferred multi-column floats given in the environment are considered as deferred single-column floats given just after `\end{paracol}`.
- The values of all local counters in the leftmost column are used as the initial values of them in the post-environment stuff.
- The `paracol` environment cannot be nested, or you will have an error message of illegal nesting.
- The commands `\switchcolumn`, `\synccounter`, `\syncallcounters` and `\flushpage`, and environments `column(*)`, `nthcolumn(*)`, `leftcolumn(*)` and `rightcolumn(*)` are *local* to `paracol` environment and thus undefined outside the environment⁹. The command `\clearpage` is of course usable outside and inside the environment but its function inside is a little bit different from outside.

7.2 Column-Switching Command and Environments

`\switchcolumn[col]`

`\switchcolumn[col]*[text]`

The command switches columns from *i* to *j* where *i* and *j* is the zero-origin ordinals of the columns from/to which we are leaving/visiting respectively. Without the optional *col*, $j = i + 1 \bmod n$ where *n* is the number of columns given to `\begin{paracol}`, while $j = col$ with the optional argument. If the command (or *[col]* if specified) is followed by a ***, the column-switching takes place after synchronization and, if specified, the optional multi-column *text* is put.

⁹Unless you dare to define them.

- Using `\switchcolumn` in a `list` and other relative environments such as `itemize` causes an ugly result without any error/warning messages. This caution is effectual for all column-switching environments too.
- If $col \notin [0, n)$, an error is reported and, if you dare to continue, you will switch to the leftmost column 0.
- The synchronization point is set just below the last line of the leading column in a page p , partly taking deferred floats into account. That is, all deferred floats are put in the pages up to $p - 1$ and at the top of p if possible. Then, if a non-leading column has footnotes and/or bottom floats and they cannot be pushed down below the synchronization point, the point is moved to the next page top.
- In a page having one or more synchronization points, stretch and shrink factors of all vertical spaces, such as those surrounding sectioning commands, are ignored. Therefore, even if you specify `\flushbottom`, the page is typeset as if `\raggedbottom` were specified.
- After a syncation point is set, top floats will not be put in the page having the point any more and thus will be deferred to the next or succeeding page.

```
\begin{column}  body  \end{column}
\begin{column*}[text]  body  \end{column*}
```

The environment `column` contains *body* for the column next to what we are in just before `\begin{column}`. The starred version `column*` does the same after synchronization and, if specified, the optional multi-column *text* is put.

- The environments are almost equivalent to;

```
{\switchcolumn  body  \par}
{\switchcolumn*[text]  body  \par}
```

except for their first occurrences which don't switch to the column 1 (i.e., right column if two-columned) but stay in the leftmost column 0. More precisely, `\begin{column(*)}` does not make column-switching if it is not preceded by `\switchcolumn` nor other column-switching environments.

- The *body* of the environments cannot have `\switchcolumn` nor other column-switching environments including `column(*)` themselves, or you will have an error message of illegal use of command/environment.
- Column-switching does not take place at `\end{column(*)}`. Therefore, texts following the environments are put in the column in which *body* resides until a column-switching command/environment is given.

```
\begin{nthcolumn}{col}  body  \end{nthcolumn}
\begin{nthcolumn*}[col][text]  body  \end{nthcolumn*}
```

The environment `nthcolumn` contains *body* for the column *col*. The starred version `nthcolumn*` does the same after synchronization and, if specified, the optional multi-column *text* is put.

- The environments are equivalent to;

```
{\switchcolumn[col]  body  \par}
{\switchcolumn[col]*[text]  body  \par}
```

- The *body* of the environments cannot have `\switchcolumn` nor other column-switching environments including `nthcolumn(*)` themselves, or you will have an error message of illegal use of command/environment.
- Column-switching does not take place at `\end{nthcolumn(*)}`. Therefore, texts following the environments are put in the column in which *body* resides until a column-switching command/environment is given.

```

\begin{leftcolumn}  body  \end{leftcolumn}
\begin{leftcolumn*}[text]  body  \end{leftcolumn*}
\begin{rightcolumn}  body  \end{rightcolumn}
\begin{rightcolumn*}[text]  body  \end{rightcolumn*}

```

The environment `leftcolumn` contains *body* for the leftmost column 0, while `rightcolumn` for the column 1 being the right column in two-column typesetting. The starred versions `leftcolumn*` and `rightcolumn*` do the same after synchronization and, if specified, the optional multi-column *text* is put.

- The environments `leftcolumn(*)` are equivalent to;

```

\begin{nthcolumn}{0}  body  \end{nthcolumn}
\begin{nthcolumn*}[text]{0}  body  \end{nthcolumn*}

```

while `rightcolumn(*)` are equivalent to;

```

\begin{nthcolumn}{1}  body  \end{nthcolumn}
\begin{nthcolumn*}[text]{1}  body  \end{nthcolumn*}

```

7.3 Command to Control Column Width

```
\columnratio{r_0, r_1, \dots, r_k}
```

The command defines the width of each column by the fraction r_i to specify the portion which i -th ($i = 0$ for the leftmost) column occupies. More specifically, the width w_i of the i -th column is defined as follows, where W is `\textwidth`, S is `\columnsep`, and n is the number of columns given to `\begin{paracol}`.

$$W' = W - (n - 1)S$$

$$w_i = \begin{cases} r_i W' & i \leq k \\ \frac{(1 - \sum_{j=0}^k r_j) W'}{n - (k + 1)} & i > k \end{cases}$$

- The equations above imply that $k < n - 1$, $r_i > 0$ and $\sum_{j=0}^k r_j < 1$. If $k \geq n - 1$, k is assumed to be $n - 2$ and all r_i such that $i \geq n - 1$ are ignored. If r_i or its sum does not satisfy the conditions, you will have an ugly result with “Overful” messages.
- The argument r_0, r_1, \dots, r_k can be empty to mean $k = -1$ to let all column widths be W'/n as default.
- The setting of column width by the command takes effect in the `paracol` environments following the command¹⁰. Therefore, though placing the command in the preamble is the most natural way¹¹, you may place this command between two `paracol` environments to change the column layout for the second one even when they appear in a page as shown in Section 6.
- In the i -th column, `\columnwidth` has w_i and, for outermost paragraphs in the column, `\linewidth` and `\hsize` have w_i as well.

7.4 Commands for Counters

```
\globalcounter{ctr}
```

The command declares that the counter *ctr* is global to all columns. An update of a global counter in a column is seen by any other columns.

¹⁰If the command is in a `paracol` environment, the command does not affect the column widths of the environment but does the next ones, though such usage is very unusual.

¹¹Or second most to not using it at all, of course.

- All column-local values of a descendant local counter of a global counter are zero-cleared when the global counter is explicitly stepped by `\stepcounter` or `\refstepcounter`, or implicitly by a sectioning command and so on.
- The counter `page` is always global but an explicit update of it by e.g., `\setcounter` in a non-leftmost column is not seen by other columns and is canceled even for the column itself after a column-switching or a page break in the column. Therefore, if you want to make a *jump* of `page`, it must be done in the leftmost column 0. Note that a jump from a page p to q can be seen in other columns even if they have gone beyond p before the column 0 makes the jump, as far as `page` having q (or its successor) is referred to by `\pageref` or through *contents* files such as `.toc`¹².

`\definethecounter{ctr}{col}{rep}`

The command defines `\thectr` being `{rep}` for the local use in the column `col`. That is, `\thectr` in the column `col` acts as if it is defined by `\renewcommand{\thectr}{rep}`.

`\synccounter{ctr}`

The command *broadcasts* the value of the local counter `ctr` in the column in which the command appears to the values in all other columns.

`\syncallcounters`

The command broadcasts the values of all local counters in the column in which the command appears to the values in all other columns.

7.5 Control of Contents Output

`\addcontentsonly{file}{col}`

The command inhibits the output of contents information to $file \in \{\text{toc}, \text{lof}, \text{lot}\}$ from columns other than `col`.

- For example, if this manual had the table of contents, `\addcontentsonly{toc}{0}` should be specified to inhibit the contents information output from `\subsection` commands in Section 4 and 5, or the table should have duplicated entries of sub-sections.
- It must be $file \in \{\text{toc}, \text{lof}, \text{lot}\}$, or you will have an error message of illegal type of contents file.

7.6 Page Flushing Commands

`\flushpage`

The command flushes pages up to the *top page* in which the leading column resides. Deferred floats which can be put in the pages up to the top page are also flushed.

`\clearpage`

The command does what `\flushpage` does and then flushes all floats still deferred if any. The deferred float flushing beyond the top page takes place at first for single-column ones creating float columns for them, and then for multi-column ones creating *float pages* only with multi-column floats, as L^AT_EX's `\clearpage` does outside `paracol` environment.

¹²Direct reference to `page` may give an inconsistent result, as you might have in ordinary L^AT_EX documents.

Acknowledgments

The author thanks to Yacine Daddi Addoun who gave the author the motivation to write the style for his bilingual document. He also thanks to the following people; Robin Fairbairns who kindly invited the style to CTAN after the author's lazy six years failing to upload the style; Joseph G. Rosenstein and Dieter Köhler who suggested the author adding the function of unbalanced column width incorporated in version 1.1.

For the implementation of the style file, the author referred to the base implementations of `\output`, `\newcounter` and related macros of L^AT_EX 2_ε written by Leslie Lamport, Johannes Braams and other authors.

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