

t-angles.sty ^{*}

(Diagram macros for tangles and braided Hopf algebras)

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1 Introduction

Usage:

<code>\usepackage[emtex]{t-angles}</code> (for emtex drivers, dviwin, dvips, yap)	or	<code>\usepackage{t-angles} ≡</code> <code>\usepackage[TPIC]{t-angles}</code> (for TPIC drivers such as dviwin, xdvi, dvips, yap, dvipdfm, kdvi)
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^{*}t-angles.sty is available from <http://www.math.ksu.edu/~lub/> or from CTAN

To use with `kluwer.cls` add the option `kluwer` :

`\usepackage[emtex,kluwer]{t-angles}` or `\usepackage[kluwer]{t-angles}` .

The main option `TPIC` is executed by default. It can be overwritten by the antagonistic option `emtex` . These two options give slightly different *.dvi output, when they are used with \LaTeX . The package works also with pdf\LaTeX . In this case both options produce identical *.pdf output. Actually, the third option `pdflatex` is executed in this case automatically. You should not type `\usepackage[pdflatex]{t-angles}` in your file unless you want to prohibit its use with \LaTeX . Another way to produce *.pdf file is to apply `dvipdfm` to the *.dvi output, obtained with the `TPIC` option.

Under pdf\LaTeX the information about slanted lines is stored in a file *.emp and read on the following pass. Consequently, the changes made in a tangle diagram are not reflected immediately in the *.pdf output. You may need several ($\simeq 2$) runs of pdf\LaTeX to see the final picture.

Acknowledgments

An optional parameter for (co)actions is proposed by Bernhard Drabant. The file `t-angles.sty` contains parts of `emlines2.sty` by Georg Horn and Eberhard Mattes and parts of `eepic.sty` by Conrad Kwok. PDF implementation of em\TeX specials is due to Hans Hagen. We have incorporated his con\TeXt support macros ‘ em\TeX specials to PDF conversion’ from `supp-emp.tex` distributed with Te\TeX . These parts of the code are used in the three options: `emtex` , `TPIC` and `pdflatex` respectively. To understand them the reader is invited to read comments in the original works.

Main features:

- The environments

<code>{tangle}</code>		<code>{array}{l}</code>	(left)
<code>{tanglec}</code>	are arrays with	<code>{array}{c}</code>	(centered)
<code>{tangler}</code>	one or more	<code>{array}{r}</code>	(right)
<code>{tangles}</code>	column style:	<code>{array}</code>	(any)

respectively. Likewise `{array}`, the `{tangles}` environment allows an optional argument `t` or `b` to align the upper base line or the bottom of the tangle with the exterior base line: `\begin{tangles}[b]{l*3cr}`.

- `\unitlens` is the global length parameter. Default value is `10 pt` .
- `\hstretch` and `\vstretch` are relative length parameters, horizontal and vertical stretch:

$$\begin{aligned}\backslash\text{unith} &= \backslash\text{hstretch} \% \text{ of } \backslash\text{unitlens} , \\ \backslash\text{unitv} &= \backslash\text{vstretch} \% \text{ of } \backslash\text{unitlens} ,\end{aligned}$$

set to an integer number of percents before the beginning of a tangle.

Default settings are `\hstretch 100` and `\vstretch 100`. The commands `\hstretch` and `\vstretch` should be used only outside of tangle environments (with an exception of embedded tangle environments).

- The commands `\hstr{<number>}` , `\vstr{<number>}` can be used inside tangle environments instead of `\hstretch<number>` , `\vstretch<number>` . They will act within their \LaTeX scope.
- The height of every row is `2 \unitv` or `\unitv` if the command `\hh` (see below) is used;
the widths of standard fragments are `0`, `.5`, `1`, `2`, `3` or `4 \unith`
- The command `\hh` obeys to \LaTeX scope rules. The command `\HH` acts in the same way as `\hh` but put at the beginning of a row works for the whole row in the `{tangles}` environment.
- The style understands the commands `\thinline` and `\thickline` .
- The command `\step[<number>]` is used to produce horizontal space `\kern <number> \unith` and works in any mode (inside and outside of the `tangle` environment).

```
\step = \step[1]      \Step = \step[2]
\hstep = \step[.5]    \hhstep = \step[-.5]
```

- Vertical spacing before the next row is produced by `\[<vertical_space>]` with optional argument (like in standard `{array}` environment).
- The command `\object#1` is used to put the object `#1` directly over or under the end of the string (inside and outside of the `{tangle}` environment). It adds a vertical space below or above as required. More space can be added as above.

The command `\Put(x_coord,y_coord)[binding_point]<object>` puts `<object>` into the intended position and works in `{tangle[cs]}` environment like a combination of `\put` and `\makebox` . Coordinates are integers, measured in `.1 \unith` , `.1 \unitv` units; `binding_point` is a combination of two letters `lcr` and `tcb` according to the usual \LaTeX rules.

The commands `\nodeu#1`, `\noded#1`, `\nodel#1`, `\noder#1`, `\noderu#1`, `\noderd#1`, `\nodelu#1`, `\nodeld#1` produce zero boxes and put `#1` into the corresponding position.

The picture

is described by the lines:

```
\vstretch 200 \hstretch 200
\begin{tangle}
\nodeu.\noded.\nodel.\noder.
\noderu.\noderd.\nodelu.\nodeld.
\end{tangle}
```

2 Macros in pictures

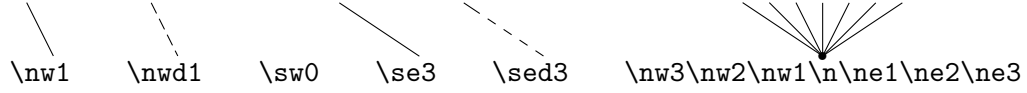
Straight lines and nodes

- The commands `\id` , `\n` , `\s` , `\node` , `\unit` , `\cunit` work also in `hh`-mode .

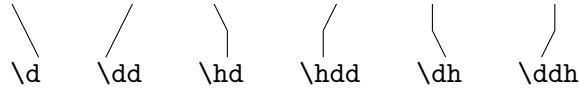
<code>\id</code>	<code>\idash</code>	<code>\n</code>	<code>\s</code>	<code>\nd</code>	<code>\sd</code>	<code>\node</code>	<code>\unit</code>	<code>\cunit</code>

The command `\FillCircDiam` denotes the filled circle diameter. It is set to an integer between 1 and 9 (here the measure unit is `0.1 \unith`). Default value is 3.

- The command `\hln <number>` produces horizontal line on `<number> \unith` .
- Argument of `\ne` , `\nw` , `\se` , `\sw` , `\ned` , `\nwd` , `\sed` , `\swd` is 0,1,2,3 or 4; 0 produces empty box and other produce (dash) lines with horizontal projections equal `<argument> \unith` cribbed into 1×2 box. The commands `\ne` , `\nw` , `\se` , `\sw` produce 1×1 box in `hh-mode` .

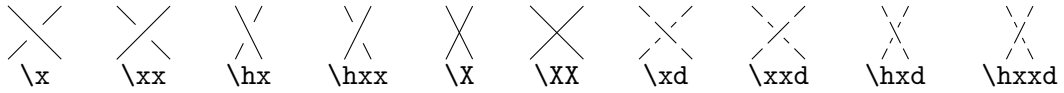


- All the following commands work in `hh-mode` and produce the similar diagrams in $.5 \times 1$ boxes.



(Under/over)crossings. Braiding and symmetry

The following crossings and dashed crossings are shown in normal mode.



The commands `\X` , `\XX` , `\x` , `\xx` work in `hh-mode` and produce similar diagrams of half width and height (1×1 boxes).

(Co)pairings.

The commands `\ev` , `\coev` work in `hh-mode` and produce the similar diagrams of half width and height ($.5 \times 1$ boxes). For convenience in `hh-mode` `\hev` \equiv `\ev` and `\heev` \equiv `\ev` .



Morphisms. Frame and dash boxes

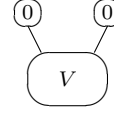
- Diagrams for `\Q f`, `\QQ f`, `\O f`, `\morph f`, `\tu f`, `\td f`, `\S`, and `\SS`.
- Diagrams for `\ox f`, `\ro p`, `\coro q`, `\Ro p`, and `\coRo q`.

- The commands `\dbox#1#2`, `\ffbox#1#2`, `\obox#1#2`, `\tbox#1#2` put $\$#2\$$ in the middle of $\#1 \times 2$ (or $\#1 \times 1$ in `hh-mode`) box with dash, rectangle, oval frame or without frame.

For example, the text

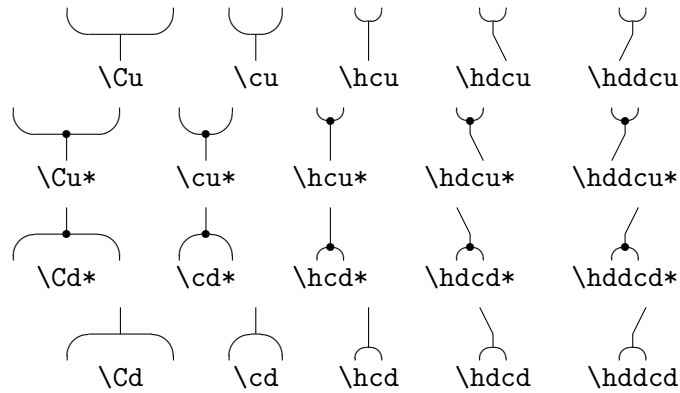
```
\begin{tangles}{rcl}
\HH\obox 10&\obox 10\\
\HH\d&\dd\\
&\hhstep\obox 3V\hhstep&
\end{tangles}
```

produces



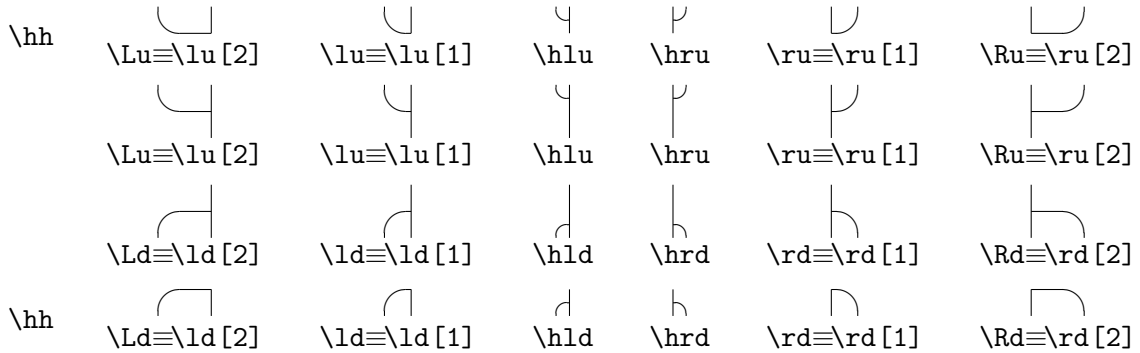
(Co)multiplications and cocycles

The commands `\cu`, `\cu*`, `\cd`, `\cd*` work in `hh-mode` and produce the similar diagrams of half width and height ($.5 \times 1$ boxes). For convenience in `hh-mode` `\hcu` \equiv `\cu` and `\hcd` \equiv `\cd`.

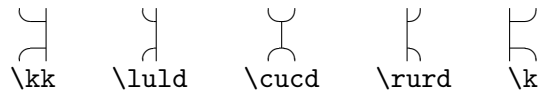


(Co)actions

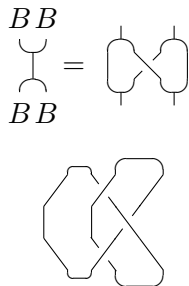
Commands `\lu`, `\ld`, `\ru`, `\rd` have optional parameter `[#1]` which equals to width of the box:



Compositions



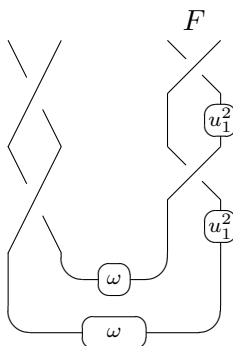
3 Examples



The first picture is produced by:

```
\[
\begin{tangle}
\object{B}\step\object{B}\
\cud\
\object{B}\step\object{B}
\end{tangle}
\;=\enspace
\begin{tangles}{lcr}
\HH \cd && \cd \
\HH \id & \times & \id \
\HH \cu && \cu
\end{tangles}
\]
```

Nested environments:



```
\[
\begin{tanglec}
\begin{tangles}[b]{c}
\vstr{200} \xx \ \ \vstr{200} \xx
\end{tangles}
\step[4]
\begin{tangles}[b]{*3c}
& \object{F} & \ \ & \xx & \ \ \id && \0{u_1^2} \ \
& \xx & \ \ \id && \0{u_1^2}
\end{tangles}
\ \
\id \Step \coRo\omega \Step \id \ \
\hstr{200} \coRo\omega
\end{tanglec}
\]
```

The level of nesting depends on the save size of your T_EX.

Note the use of optional argument [b] to align the subtangles at the bottom.

4 Development

History and versions

The style was produced by the first author in 1994. It was completely modified and essentially improved by the second author in 1997 for real-life applications in [1].

04.04.99→20.04.00 The output of commands `\tu#1`, `\td#1`, `\ro#1`, `\coro#1`, `\Ro#1`, `\coRo#1` slightly differs. Now they fit their boxes.

20.04.00→10.09.00 Dashed crossings are represented by the commands `\xd`, `\xxd`, `\hxd`, `\hxxd`.

10.09.00→22.04.06 It is possible to use the package with pdfL^AT_EX.

References

- [1] Yu. N. Bespalov, T. Kerler, V. V. Lyubashenko, and V. G. Turaev, *Integrals for braided Hopf algebras*, J. Pure and Appl. Algebra **148** (2000), no. 2, 113–164, Available as <http://arXiv.org/abs/q-alg/9709020>.

Directions for modification

- In the future some problems can be solved by introducing global (logical) parameters that switch configuration and behavior of certain families of commands in questionable situations.
- To adopt commands like in `{picture}` environment to produce special fragments of one time use.
- To make the second argument of the command `\Put(#1)[#2]#3` optional.
- To produce command index for this manual.
- To add possibility to change size of circle in circled morphisms (in particular, to turn `\morph` into a special case of `\0`).

Suggestions are welcome.

A Exercises

How to produce the following ?

