`t-angles.sty` *

(Diagram macros for tangles and braided Hopf algebras)

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Contents

1 Introduction

Usage:

`\usepackage[emtex]{t-angles}` (for `emtex` drivers, `dviwin`, `dvips`, `yap`)

or

`\usepackage{t-angles}` ≡ `\usepackage[TPIC]{t-angles}` (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 pdfLaTeX. 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 pdfLaTeX 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 pdfLaTeX 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 emTeX specials is due to Hans Hagen. We have incorporated his conTeXt support macros 'emTeX specials to PDF conversion' from `supp-emp.tex` distributed with TeTeX. 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. In order to distinguish between ordinary LaTeX and pdfLaTeX modes, Heiko Oberdiek's package `ifpdf.sty` is loaded.

Main features:

- The environments

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

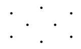
  `\unith` = `\hstretch` % of `\unitlens` ,
  `\unitv` = `\vstretch` % of `\unitlens` ,

  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 `\thinlines` and `\thicklines` .
- 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.

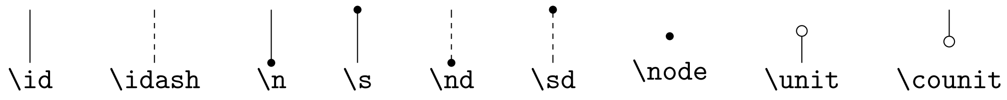
  The picture  is described by the lines:

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

2 Macros in pictures

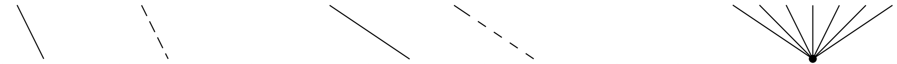
Straight lines and nodes

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

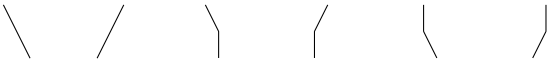
  The command `\FillCircDiam` denotes the filled circle diameter. It is set to an integer between 1 and 9 (here the measure unit is 0.1 `\unith`). Default value is 3.

- 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 .



`\nw1` `\nwd1` `\sw0` `\se3` `\sed3` `\nw3\nw2\nw1\n\ne1\ne2\ne3`

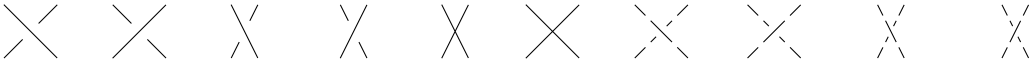
- All the following commands work in `hh`-mode and produce the similar diagrams in `.5`×`1` boxes.



`\d` `\dd` `\hd` `\hdd` `\dh` `\ddh`

(Under/over)crossings. Braiding and symmetry

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

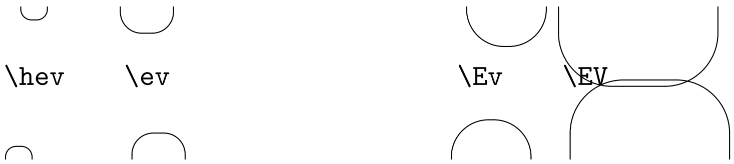


`\x` `\xx` `\hx` `\hxx` `\X` `\XX` `\xd` `\xxd` `\hxd` `\hxxd`

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

(Co)pairings.

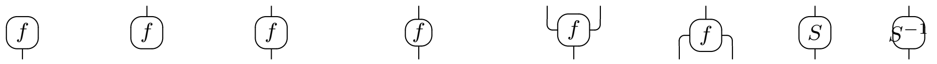
The commands `\ev` , `\coev` work in `hh`-mode and produce the similar diagrams of half width and height (`.5`×`1` boxes). For convenience in `hh`-mode `\hev` ≡ `\ev` and `\hev` ≡ `\ev` .



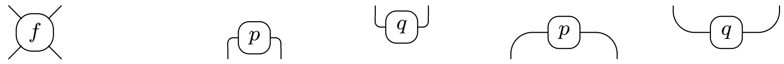
`\hev` `\ev` `\Ev` `\EV`

`\hcoev` `\coev` `\Coev` `\COEV`

Morphisms. Frame and dash boxes

- 

  `\Q f` `\QQ f` `\O f` `\morph f` `\tu f` `\td f` `\S` `\SS`

- 

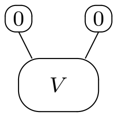
  `\ox f` `\ro p` `\coro q` `\Ro p` `\coRo q`

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

  For example, the text

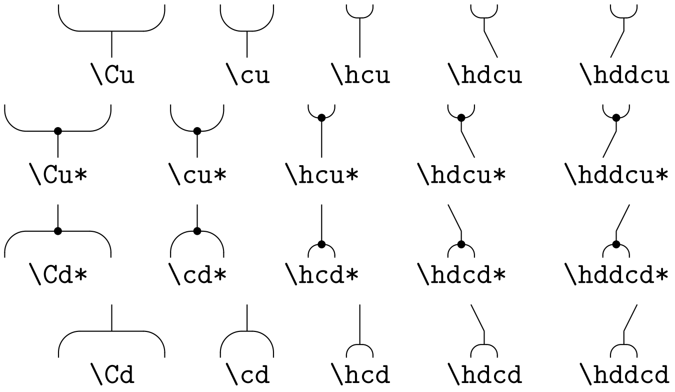
  ```
  \begin{tangles}{rcl}
  \HH\obox 10&&\obox 10\\
  \HH\d&&\dd\\
  &\hhstep\obox 3V\hhstep&
  \end{tangles}
  ```

  produces

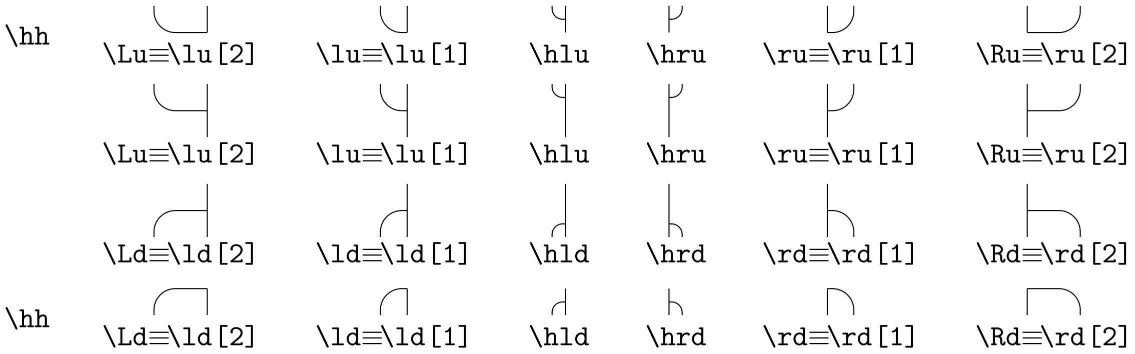
(Co)multiplications and cocycles

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

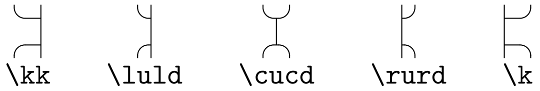


(Co)actions

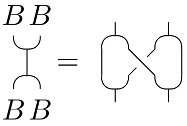
Commands `\lu` , `\ld` , `\ru` , `\rd` have optional parameter `[#1]` which equals to width of the box:

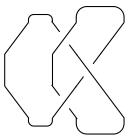


Compositions



3 Examples

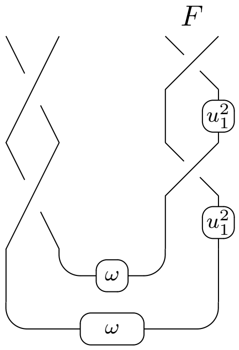




The first picture is produced by:

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

Nested environments:



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

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

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 pdfLATEX.
22.04.06→14.08.06	Behaviour of the package with pdfeLATEX of MiKTEX 2.5 is corrected.

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 `\O`).

Suggestions are welcome.

A Exercises

How to produce the following ?