TeXlattice - draw accelerator lattices with LaTeX
using pgf/tikz

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v1.1 (August 12, 2014)

Contents

1 Installation

1.1 Copy lattice.sty

You just need to copy the lattice.sty file to a place where your LaTeX installation can recognize it. This can be

- the same folder as your .tex document
- in the LaTeX system or user tree

e.g. to add it to the system tree for texlive under ubuntu:

```
sudo mkdir -p /usr/local/share/texmf/tex/latex/lattice/
sudo cp lattice.sty /usr/local/share/texmf/tex/latex/lattice/
sudo mktexlsr (or sudo texhash)
```

For this path there is also a Makefile prepared, so just enter

```
sudo make install
```

Otherwise read the documentation of your LaTeX distribution.

1.2 Required packages

- tikz, pgf
- siunitx
- ifthen
- xargs

2 What is missing?

- The look of the elements can definitely be improved. Feel free to do it! The only constraint is that it must be drawn as a tikz node. Ok, and one has to adjust the bounding box and center the manet in it...
- More element types can be added easily - please report what you need!
- A legend command showing only the element types which are used in the current lattice would be nice, but I did not find a way to do it yet (with my limited knowledge about latex...).

3 Known issues

- The fade environment usually sets all colors to gray (in addition to reducing opacity). This does not work if a color was set by `\setelementcolor`, `\setdriftcolor` or `\setmarkercolor`
- the dipoles border thickness depends on the rotation angle. This has something to do with drawing it as path and not as node to realize the curved shapes.
- the sector dipoles have a to large bounding box.

4 lattice environment

To draw a lattice just add

`\usepackage{lattice}`

to your preambel and use the lattice environment. the lattice environment has 2 optional arguments:

1. `[tikz options]` give any options for the tikzpicture (e.g. overlay)
2. `[scale]` scale whole picture (default: 1)

5 Within lattice environment

5.1 Elements

- `\drift{length/m}[name (default: none)]`
- `\dipole{name}{length/m}{bending angle/deg}[type (default: br)][thickness/m (default 0.4)]` the `type` option allows to select different dipole shapes. It can be:
  - br for a bend rectangle magnet (parallel entrance/exit surfaces)
  - r for a rectangle magnet
  - s for a sector magnet (entrance/exit surface 90 degree to beampipe)
- `\quadrupole{name}{length/m}[thickness/m (default 0.5)]`
- `\sextupole{name}{length/m}`
- `\kicker{name}{length/m}`
- `\cavity{name}{length/m}`
- `\solenoid{name}{length/m}[thickness/m (default 0.2)]`
- `\source{name}`
- `\screen{name}`
- `\valve{name}`
- `\marker{name}[length/m (default 0.35)]` a line perpendicular to beamline of given length

5.2 Modify your lattice/elements

- `\rotate{angle/deg}` "bends" the beamline. e.g. to set starting angle
- `\start{coordinate/m}` sets starting point of lattice. use before first element coordinate in form (x,y) or any tikz label, e.g. (mylabel.east) hint: use with `\savecoordinate` to connect lattices! (compile twice!)
- `\drawrule{start coordinate/m}[tick distance/m (default: 1)]` a rule to visualize lattice size. coordinate in form (x,y) or any tikz label, e.g. (mylabel.east)
- `\legend{position/m}[scale (default: 1)]` a legend with all element types. position is north east of legend box. the scale option scales the whole box including the text, which has the usual label textsize for scale=1

5.2.1 Labels

- `\turnlabels` moves labels to other side of elements (swap with marker labels)
- `\rotatelabels{angle/deg}[anchor (default: automatic)]` allows rotation of element labels. the anchor sets the center of rotation (north, center, south west, ...). west corresponds to labels first character.
- environment `labeldistance{distance/m}` sets distance of text labels to element center for all elements within this environment (default is 0.35)
- `\setlabelfont{fontsize}` text label fontsize (default is `\normalsize`)

5.2.2 Colors

- `\setdriftcolor{color (default black)}` for all following drifts
- `\setmarkercolor{color (default red)}` for all following markers
- `\setelementcolor{type}{color (default depends on type)}` define color for one element-type
- environment `fade{opacity (default: 0.25)}` sets the opacity of all elements within the environment to fade out regions of the lattice - e.g. for presentations. This can also be used to completely hide regions by setting opacity to zero.

5.3 Access lattice coordinates

You can use element coordinates to draw anything you want using pgf/tikz. You can even connect lattices to draw injection/extraction or a complete accelerator facility.

- `\savecoordinate{name}[position (default: east)]` saves coordinate of previous element to access it later.
  - position specifies the exact place of the element (north, center, south west, ...). Here east is always downstream and west upstream.

- you can use all tikz/pgf commands within lattice environment to draw anything.
- You can also connect multiple lattices. use tikz overlay option (1. argument of lattice) and `\start`. See example 3.
- ! DON'T use bare numbers as names (e.g. (1)) These are the internal element identifiers.

6 Remarks

- lengths are set in meter, so you write {1.32} for 1.32m.
- beamline with angle 0 goes to the right, positive angles bend counter clockwise.
- picture scale: for lattice scale=1 an element of 1m length is plotted with 2cm length
- minimum element length 0.01m (drifts can be shorter)
- maximum drift length <2.9m (just add a second drift to get a longer one)
- maximum rule length < 3x29m
- if you refer to a coordinate from another lattice (another tikzpicture) you have to compile twice