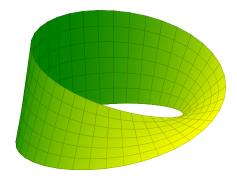
Quick Reference

PGFPLOTS

```
\begin{tikzpicture}
\begin{axis}[
 hide axis,
 view = {40}{40},
\addplot3[
  surf,
  colormap/greenyellow,
  shader = faceted interp,
  z buffer = sort,
  point meta = x,
 domain = 0:360,
  domain y = -0.5:0.5,
  samples = 40,
  samples y = 7,
\{(1 + 0.5 * y * \cos(x / 2))) * \cos(x)\},\
\{(1 + 0.5 * y * \cos(x / 2))) * \sin(x)\},\
\{0.5 * y * \sin(x/2)\}\);
\end{axis}
\end{tikzpicture}
```



Ralph Schleicher

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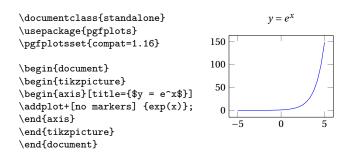
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Nomenclature

| \foo | T _E X control sequence. |
|---|---|
| foo _{env} | LATEX environment foo. |
| $\mathtt{foo}_{\mathrm{stv}}$ | PGFPLOTS style with key foo. |
| foo | Terminal symbol, literal text. |
| $\langle foo \rangle$ | Non-terminal symbol, metasyntactic variable. |
| $\langle foo \rangle \rightarrow \langle bar \rangle$ | Production rule; $\langle foo \rangle$ can be replaced by $\langle bar \rangle$, |
| | $\langle foo \rangle$ and $\langle bar \rangle$ are implicit groups. |
| ⟨foo⟩ ⟨bar⟩ | Sequence; $\langle foo \rangle$ followed by $\langle bar \rangle$. |
| $\langle foo \rangle \langle bar \rangle$ | Choice; $\langle foo \rangle$ or $\langle bar \rangle$. |
| $\langle foo \rangle^*$ | $\langle foo \rangle$ can occur zero or more times. |
| $\langle foo \rangle^+$ | (foo) can occur one or more times. |
| $\langle foo \rangle^{?}$ | $\langle foo \rangle$ is optional. |
| () | Explicit group. |
| > ⟨key⟩ = ⟨value⟩ | User option, $\langle key \rangle$ and $\langle value \rangle$ are implicit |
| | groups. |
| > ⟨key⟩ | User option without a value. |
| 42 J | Default value is 42. |
| ┙ | Line continuation mark. |
| ⟨empty⟩ | Nothing. |
| ⟨newline⟩ | Newline character, ^^M in T _E X. |
| ⟨dimension⟩ | A legitimate T _E X dimension. |
| ⟨number⟩ | $(-\infty,\infty)\cap\mathbb{R}$. |
| ⟨positive number⟩ | $(0,\infty)\cap\mathbb{R}.$ |
| (non-negative number) | $[0,\infty)\cap\mathbb{R}.$ |
| (integer) | $(-\infty,\infty)\cap\mathbb{Z}$. |
| (positive integer) | $(0,\infty)\cap\mathbb{Z}$. |
| ⟨non-negative integer⟩ | $[0,\infty)\cap\mathbb{Z}$. |
| - | |

1 General

1.1 Document Structure



1.2 PGFPLOTS Options

```
\label{eq:losset} $$ \left( \langle key/value\ list \rangle \right) $$ \left( \langle key/value\ list \rangle \rightarrow \left( \langle key \rangle = \langle value \rangle_{\bullet} \right)^{*} $$
```

Options are supplied as a \(\lambda key/value \ list \rangle \). The \(\pgfplots / \) and \(\tikz / \) prefixes in \(\lambda key \rangle \) can be omitted in the scope of PGFPLOTS commands. Please note that a trailing comma in \(\lambda key/value \ list \rangle \) does no harm.

1.3 Key Handlers

```
\pgfplotsset{\langle key\rangle \left\ \left\ key\rangle \left\ \left\ key\rangle \left\ \left\ key\rangle \left\ \left\ key\rangle \left\
```

1.4 Mathematical Expressions

See the ${
m Ti}{\it k}{
m Z/PGF}$ manual for a detailed description.

Use parenthesis, (and), for grouping. Arguments and values of trigonometric functions are in degree angle.

Arithmetic Operators: +, - (also unary minus), *, /, ^ (exponentiation),

 $!\ (factorial,\,post fix\,operator),\, \verb"r"\ (radian,\,post fix\,operator,\,see\,\verb"deg").$

 $Relational\ Operators : ==,\ !=,<,<=,>,>=.$

Logical Operators: ! (not, prefix operator), | | (or), && (and).

 $Conditionals: \langle condition \rangle ? \langle true \rangle : \langle false \rangle.$

Constants: pi, e, false, true.

Unary Functions: abs, sign, int, frac (fractional part), round, floor, ceil, factorial (see !), iseven, isodd, isprime, sqrt, exp, ln, log10, log2, sin, cos, tan, cot, sec, cosec, asin, acos, atan, deg (degree from radian), rad (radian from degree), sinh, cosh, tanh.

Binary Functions: div (integer division), mod, Mod (unsigned result), gcd, pow (see $\hat{}$), atan2, veclen (vector length in \mathbb{R}^2).

n-ary Functions: min, max.

 $Pseudo-Random\ Number\ Functions\ (Uniform\ Distribution)\colon rnd\ ([0,1]\cap\mathbb{R}), \ rand\ ([-1,1]\cap\mathbb{R}), \ random\ (n)\ ([1,n]\cap\mathbb{N}), \ random\ (m,n)\ ([m,n]\cap\mathbb{Z}).$

2 Axis Environments

```
\begin{axis} [\langle axis \ options \rangle]? \langle axis \ options \rangle \rightarrow \langle key/value \ list \rangle
```

```
\mathtt{axis}_{env} can also be \mathtt{semilogxaxis}_{env}, \mathtt{semilogyaxis}_{env}, or \mathtt{loglogaxis}_{env}.
```

```
ightharpoonup every \langle type \rangle? axis \langle type \rangle → (linear|semilogx|semilogy|loglog)

Define default axis options.
```

▷ xmode|ymode|zmode = normal|linear|log option
 Customize axis scaling; linear is a synonym for normal.

```
\triangleright log basis (x|y|z) = \langle empty \rangle | \langle positive\ number \rangle option
```

The basis for logarithmic axis scaling. Empty means to apply the natural logarithm (base e) to any input coordinate – if the axis scaling is logarithmic – and use the decadic/common logarithm (base 10) for displaying tick labels. Any non-empty value causes both, coordinates and tick labels, to use the logarithm with base $\langle number \rangle$.

3 Plots

\addplot[\(\rho\) fions\)]? \(\line(input data\) \(\rho\) trailing TikZ path commands\); \addplot (without options) and \addplot+[\(\rho\) plot options\)] utilize default options from the cycle list. \addplot[\(\rho\) plot options\)] only use the manually provided options.

be every axis plot (no n)? style Define $\langle plot \ options \rangle$ for all plots or for the n^{th} plot of every axis. Plot numbers are zero-based

3.1 Input Data

⊳ empty line = <u>auto</u>|none|scanline|jump option How to handle empty lines in ⟨coordinates list⟩, none means to do nothing, jump means to insert a discontinuity.

3.1.1 Coordinates List

```
\langle input\ data \rangle \rightarrow coordinates \ \{\langle coordinates\ list \rangle\}  \langle coordinates\ list \rangle \rightarrow \langle coordinates \rangle^*  \langle coordinates \rangle \rightarrow \langle x, y, z \rangle \ (+- (u, v, w))^? \ ([\langle meta\ data \rangle])^?
```

Read input data from a sequence of coordinates. x, y, and z are the point coordinates. u, v, and w are the error coordinates (reliability bounds) for error bar plots. Coordinate z and w are only mandatory for 3D plots. Empty lines in the $\langle coordinates \ list \rangle$ indicate discontinuities; use $\$ when gathering coordinates in a $T_{\rm F}X$ macro.

```
> plot coordinates/math parser = <u>true</u>|false option

Whether or not to enable mathematical expressions in every coordinate
```

Whether or not to enable mathematical expressions in every coordinate inside of a $\langle coordinates \ list \rangle$.

3.1.2 Table Data

```
⟨input data⟩ → table [⟨table options⟩]? {⟨table data⟩}
⟨table data⟩ → ⟨file name⟩ | ⟨inline table⟩
Read input data from table columns.
```

$$\begin{split} &\langle coordinate \rangle \rightarrow x \, |y \, |z \, | \, (x \, |y \, |z) \; \; \text{error} \; \; (\text{plus} \, |\text{minus})^{?} \, |\text{meta} \\ &\quad \text{Column names are case sensitive and have to exist. Use } \, \{\langle column \, name \rangle\} \; \text{to} \\ &\quad \text{quote non-trivial column names. The first column has index zero.} \\ &\quad \text{Within } \, \langle expression \rangle \, \text{thisrow} \, \langle column \, name \rangle \} \; \text{and} \end{split}$$

\thisrowno\(\column\) index\(\) yields the cell value of the specified column. Likewise, \coordindex yields the index of the current set of coordinates and \lineno\) yields the total line number. Both numbers start counting at zero.

Whether or not to check $\langle table\ data \rangle$ for column names. If enabled, the first non-comment line is checked for column names. That means if any element is not a number, all entries are treated as column names.

```
ightharpoonup table/skip first n = \underline{0} | \langle non\text{-}negative\ integer} \rangle option
Don't process the first n lines in \langle table\ data \rangle.
```

▶ table/ignore chars = {}|⟨comma-separated list⟩ option \triangleright table/white space chars = $\{\} | \langle comma\text{-}separated \ list \rangle \}$ option \triangleright table/comment chars = $\{\underline{\}} \mid \langle \overline{comma} \cdot separated \ list \rangle$ option

Extra characters to be ignored, treated like a whitespace character (beside space and tab), or treated like a comment start character (beside # and %).

Use \\ as the row seperator if you experience problems with \(\(newline\)\), for example with inline table data or when gathering table data in a TeX macro.

▷ table/col sep = space|tab|comma|semicolon|colon → option |braces|&|ampersand

A space column separator means one or more space or tab characters. With braces, every table cell looks like {\(contents \) \} and whitespace characters between adjacent table cells is ignored. A & column separator implies 'table/trim cells = true'.

option ▶ table/read completely = auto|true|false Whether or not to read the whole table into memory. Use with care!

▶ table/search path = {}|⟨comma-separated list⟩

▶ table/search path/implicit . = true|false option

Search path for input files, . means to use the standard TEX procedure.

\pgfplotstableread{\langle file name \rangle \foo \addplot table [\langle table options \rangle] {\foo};

Read table data once so that you can use it multiple times; \foo is a user-defined command sequence.

3.1.3 Mathematical Expressions

 $\langle input \, data \rangle \rightarrow expression^? \{\langle expression \rangle\}$ $\langle input \, data \rangle \rightarrow (\langle x\text{-expression} \rangle, \langle y\text{-expression} \rangle, \langle z\text{-expression} \rangle)$

Create input data by sampling a mathematical expression over an argument domain. The second form can be used to create parametric plots. Say $\{\langle x\text{-}expression \rangle\}\$ if $\langle x\text{-}expression \rangle$ contains parenthesis or commas. The (z-expression) is only mandatory for 3D plots.

 \triangleright domain = $-5:5|\langle x_1\rangle:\langle x_2\rangle$ option \triangleright domain y = $\langle empty \rangle | \langle y_1 \rangle : \langle y_2 \rangle$ option

Define the argument domain for the x-axis to the closed interval $[x_1, x_2]$. Likewise for the y-axis for 3D plots. If domain y is empty, use the value of domain.

⊳ samples = 25|⟨non-negative integer⟩ ▷ samples y = ⟨empty⟩ | ⟨non-negative integer⟩

The number of samples to be generated. Samples are equally spaced over the corresponding argument domain. If 'samples y' is empty, use the value of samples.

▷ samples at = {}|⟨comma-separated list of numbers⟩

Explicit argument values for sampling (expression). This option always overrides the domain and samples options.

(comma-separated list of numbers) can contain . . . expressions, for example '{-2, -1.8, ..., 2}'.

 \triangleright variable = $\underline{x} \mid \langle variable \ name \rangle$

option option

option

option

option

option

▷ variable y = y|⟨variable name⟩

The variable name containing the argument value when evaluating ⟨expression⟩.

3.2 Line Plots









option

Connect points by straight lines. This is the default.

option \triangleright /tikz/tension = $0.55 |\langle number \rangle$ option

Connect points by a smooth curve. For best results, points should be equidistant and the bending angles should be less than about 30°. The tension option controls the sharpness of the corners; 0 yields sharp corners and 1 yields a circle if the path is a square.

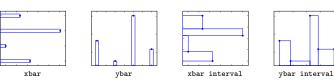
 \triangleright /tikz/const plot mark (<u>left</u>|mid|right)

option option

Connect points with horizontal and vertical line segments. 'const plot' is an alias for 'const plot mark left'. Markers are placed on the left corner, in the middle, or on the right corner of the horizontal line segments. Use 'const plot, no markers' to omit the markers.

▷ /tikz/jump mark (left|mid|right) option Like 'const plot' but omit the vertical line segments.

3.3 Bar Plots



option option

Render coordinates as horizontal or vertical bars respectively.

▷ /pgf/bar width = 10pt|⟨dimension⟩|⟨number⟩

Width of a single bar. (dimension) is a TFX dimension and (number) is in axis units. Value can be a mathematical expression. The fully computed value is then available in \pgfplotbarwidth.

▷ /pgf/bar shift = Opt|⟨dimension⟩|⟨number⟩

option

option

option

option

Off-center distance for the bars. (dimension) is a TFX dimension and (number) is in axis units. Value can be a mathematical expression. The fully computed value is then available in $\protect\operatorname{\mathtt{Ngfplotbarshift}}$.

⊳ xbar style \triangleright xbar(= 2pt|\langle dimension\rangle |\langle number\rangle)^? option ⊳ ybar style \triangleright ybar(= 2pt | $\langle dimension \rangle | \langle number \rangle)^?$ option

Predefined axis style for bar plots; implies /tikz/xbar or /tikz/ybar respectively, bar shift autosty, and bar cycle liststy. The default handler takes one optional argument which is passed on to bar shift autosty.

▷ bar shift auto ▷ bar shift auto = 2pt|⟨dimension⟩|⟨number⟩

Predefined axis style setting /pgf/bar shift to the correct value based on the current plot number and the total number of plots. Argument is the distance between adjacent bars of a group.

When n bar plots are added to an axis, the total width for a group of bars is $n \times \langle bar \ width \rangle + (n-1) \times \langle bar \ shift \ auto \rangle$.

▷ bar cycle list style

Predefined axis style installing a cycle list for bar plots.

 \triangleright bar direction = <u>auto</u>|x|y Explicitly set the bar plot direction. Not needed if you say, for example 'ybar, bar width = 1', because the direction is clear from the context.

option option

Like /tikz/xbar or /tikz/ybar respectively, but draw the bar width as an interval from this point to the next point. You need one extra point to define the interval for the last bar.

style option ▷ vbar interval style ybar interval(= 1 | ⟨relative width⟩)[?]

Predefined axis style for interval bar plots; implies /tikz/xbar interval or /tikz/ybar interval respectively and bar cycle $list_{stv}$. The default handler takes one optional argument to scale the intervals.

style ∀ yticklabel interval boundaries style ▷ zticklabel interval boundaries style

Axis style to display the interval bounds in the tick labels.

3.4 Comb Plots





option option

Render coordinates as horizontal or vertical lines respectively.

3.5 Quiver Plots

▷ quiver = {⟨quiver options⟩}

option

Render coordinates as small arrows. The origin of the arrow is at the final point coordinates (x, y, z) and the direction and length of the arrow is defined by the direction coordinates (u, v, w).

The quiver/ prefix can be omitted within \(\langle quiver options \rangle \).

 \triangleright quiver/(u|v|w) = $\underline{0}$ |\langle expression\rangle

option

The direction coordinates of the arrows. Within (expression), x, y, and z are bound to the final point coordinates.

For parametric plots use 'variable = t' and 'quiver/u = f(t)' and 'quiver/v = g(t)' to access the parameter.

```
\addplot[
 quiver = \{u = \{-\sin(t)\}, v = \{\cos(t)\}\},\
({cos(t)}, {sin(t)});
```

 \triangleright quiver/(u|v|w) value = 0|\langle number \rangle

option

Like quiver/u, quiver/v, and quiver/w respectively but without parsing mathematical expressions. However, \thisrow{\column name}} and similar code works.

▶ quiver/colored option

ightharpoonup quiver/colored = mapped color| $\langle color \rangle$ option

Set a different color for each arrow. quiver/colored is an alias for

'quiver/colored = mapped color'. Please note that

 $\langle color \rangle$, quiver = ...' is more efficient if $\langle color \rangle$ is constant.

 \triangleright quiver/scale arrows = $\underline{1} | \langle number \rangle$

option

Scale all arrows by a constant factor.

▷ quiver/update limits = true|false

Whether or not the coordinates of the arrow heads shall be considered when determining the axis limits.

⊳ quiver/every arrow style

Style to customize arrows individually at visualization time.

puiver/before arrow

▷ quiver/after arrow code

Run \(\langle T_{E}X code \rangle\) before and after drawing a single arrow. Empty by default.

 puiver/quiver legend style

Style that redefines legend image code in order to produce a suitable legend for quiver plots.

4 Lines and Markers

4.1 Line Width

style style /tikz/thin style /tikz/semithick style style style style Predefined line widths.

 \triangleright /tikz/line width = $0.4pt | \langle dimension \rangle$ option

Set the line width.

4.2 Line Cap

▷ /tikz/line cap = butt|rect|round Set the line cap style.

rect

option

option

4.3 Line Join

▷ /tikz/line join = miter|bevel|round Set the line join style.





▷ /tikz/miter limit = 10|⟨number⟩

option

When the ratio of the miter length to the line width is greater than $\langle number \rangle$, the miter join is replaced by a bevel. A miter limit $\ell = 1/\sin(\alpha/2)$ for $\alpha \in (0^{\circ}, 180^{\circ})$ will create a bevel join for angles less than $\alpha = 2 \cdot \arcsin(1/\ell)$.

4.4 Dash Pattern

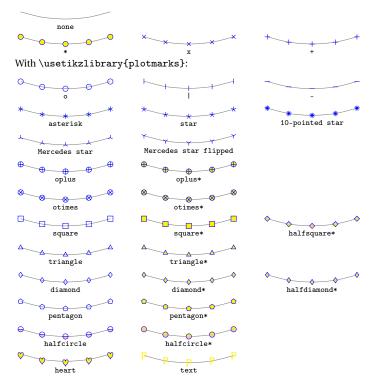
| | styl |
|-------------------------------|------------------------------|
| | styl |
| | styl |
| | styl |
| > /tikz/dashdotdotted | styl |
| | styl |
| | styl |
| | styl |
| > /tikz/densely dashdotdotted | styl |
| | styl |
| | styl |
| | - · - · - · - · - · styl |
| | - · · - · · - · · - · · styl |
| Predefined line styles. | |

▷ /tikz/dash pattern = ((on|off) ⟨dimension⟩)⁺ option Set the dash pattern (line style) for drawing lines, e.g., 'dash pattern = on 3.5mm off 0.7mm'.

▷ /tikz/dash phase = Opt|⟨dimension⟩ option Start the dash pattern at offset (dimension).

4.5 Markers

Standard markers:



5

All markers plotted with 'mark options = {draw = blue, fill = yellow}' and 'mark color = pink'. You can rotate makers with, e.g., 'mark options = {rotate = 90}'. ▷ /tikz/mark = *|⟨marker⟩ option Use (marker). ▷ /tikz/mark size = 2pt|⟨dimension⟩ option Marker size, $\langle dimension \rangle$ is either the radius or about half the width or height. ▷ /tikz/mark repeat = 1 | ⟨integer⟩ option Draw a marker at every (integer)th sample. option

 \triangleright /tikz/mark phase = $\underline{1} | \langle integer \rangle$ Draw the first marker at the *(integer)*th sample; *(integer)* is one based.

▷ /tikz/mark indices = {}|{⟨comma-separated list of integers⟩} Explicit sample indices for drawing markers. (comma-separated list of integers) can contain . . . expressions, for example

'mark indices = $\{1, 2, ..., 7\}$ '. style

▷ /tikz/mark options = {⟨options⟩}

option Redefine 'every mark' so that it sets (options).

Disable markers; even for cycle lists that contain markers.

This style is applied before drawing a marker.

▷ /pgfplots/no markers

▷ /pgf/mark color = white | ⟨color⟩ option Additional fill color for halfcircle, halfcircle*, halfdiamond*, and halfsquare* markers.

 \triangleright /pgf/text mark = p|\langle text\rangle option Define the text for 'mark = text'.

▷ /pgf/text mark as node = false|true option Whether or not to draw text markers as nodes.

▷ /pgf/text mark style = {⟨options⟩} option

Customize the appearance of text markers. When 'text mark as node' is true, 'text mark style' are \node options. Otherwise, 'text mark style' are \pgftext options.

5 Color Data

5.1 Colors

Color support is provided by the xcolor package. Standard color names:



▷ /tikz/color = ⟨color⟩

Set the color for drawing and filling. You can omit the option key if $\langle color \rangle$ is a color name.

▷ /tikz/draw = ⟨color⟩ option ▷ /tikz/fill = ⟨color⟩ option

Set the color for drawing or filling respectively. You can use none as \(color \) to disable drawing or filling.

 $\definecolor{\langle name \rangle} {\langle model \rangle} {\langle spec \rangle}$ $\langle model \rangle \rightarrow \mathtt{rgb} \, | \, \mathtt{cmy} \, | \, \mathtt{cmyk} \, | \, \mathtt{hsb} \, | \, \mathtt{Hsb} \, | \, \mathtt{tHsb} \, | \, \mathtt{gray} \, | \, \mathtt{RGB} \, | \, \mathtt{HSB} \, | \, \mathtt{Gray} \, | \, \mathtt{HTML} \, \downarrow \, \mathsf{HSB} \, | \, \mathtt{HSB} \, | \,$ wave $\langle \text{rgb } spec \rangle \rightarrow x, x, x$ $\langle \text{cmy } spec \rangle \rightarrow x, x, x$ $\langle \mathtt{cmyk} \ spec \rangle \rightarrow x, x, x, x$ $\langle \mathtt{hsb} \; spec \rangle \to x$, x, x $\langle \text{Hsb } spec \rangle \rightarrow H, x, x$ $\langle \mathtt{tHsb} \; spec \rangle \rightarrow H, \; x, \; x$ $\langle \operatorname{gray} \operatorname{spec} \rangle \to x$ $\langle RGB \ spec \rangle \rightarrow L, L, L$ $\langle \mathtt{HSB} \; spec \rangle \to M$, M, M $\langle \mathtt{Gray} \ spec \rangle \to N$ $\langle \mathtt{HTML}\ spec \rangle \rightarrow [\mathtt{0000001}_{16}, \mathtt{FFFFFF}_{16}]$ $\langle wave spec \rangle \rightarrow [363, 814]$

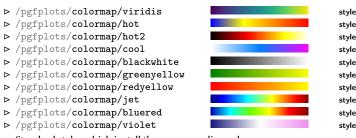
5.2 Color Maps

style

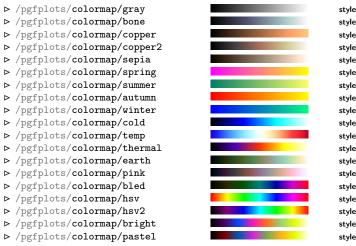
▷ /pgfplots/colormap name = hot | ⟨color map name⟩ option Select a predefined color map.

 $x = [0, 1], H = [0, 360], L = [0, 255] \cap \mathbb{Z}, M = [0, 240] \cap \mathbb{Z}, \text{ and } N = [0, 15] \cap \mathbb{Z}.$ All

colors are defined in the sRGB color space. HSB is a synonym for HSL.



Standard styles which install the corresponding color map.



Styles provided by \usepgfplotslibrary{colormaps} which install the corresponding color map.

 \triangleright /pgfplots/color of colormap = $\langle value \rangle$ (of $\langle colormap \rangle$)? Set the color for drawing and filling from a color map. (value) is a number in the closed interval [0, 1000]. (color map) is either a color map name or a color map style.

▷ /pgfplots/const color of colormap = ⟨value⟩ → option $(of \langle color map \rangle)^?$

Like color of colormap but with piecewise constant interpolation.

option

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