

# Graphing/Drawing Tools for Physics Research

Especially, TikZ.

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## Graphing - popular tools

- ▶ What software do you use for plotting? (Multi-select)
  - ▶ Mathematica (54)
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  - ▶ MS Excel (23)
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  - ▶ **ggplot** (2)
  - ▶ LabView (2)
  - ▶ etc...

<http://bit.ly/2wdEGfC>, Bold face: free software.

## Drawing - popular tools

- ▶ MS PowerPoint
- ▶ Adobe Illustrator
- ▶ HancomOffice Hanword
- ▶ **GeoGebra**
- ▶ **TikZ**
- ▶ **Inkscape** / **GIMP** / mspaint
- ▶ draw by hand

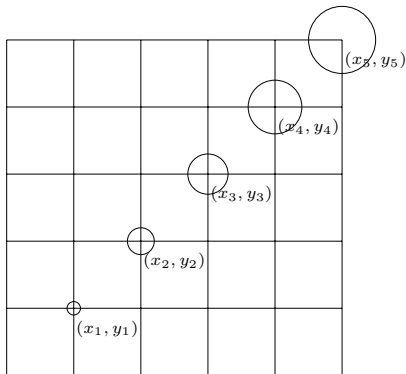
Bold face: free software.

# TikZ

- ▶ `\draw (0,0) -- (1,1);`
- ▶ `\draw (0,0) rectangle (1,1);`
- ▶ `\draw (0,0) circle [radius=0.5];`
- ▶ `\node at (0,0) {Some text};`
- ▶ `\draw plot (\x, {sin(\x)});`
- ▶ `\draw (0,0) -- ($ (2,0) + (120:2) $);`

## for loop in TikZ

```
\draw (0,0) grid (5,5);  
\foreach \i in {1,2,...,5}{  
\draw (\i,\i) circle [radius=0.1*\i];  
\node at (\i+0.5, \i-0.3)  
{\scriptsize $ (x_{\i},y_{\i}) $};  
}
```



# Drawing animation with TikZ

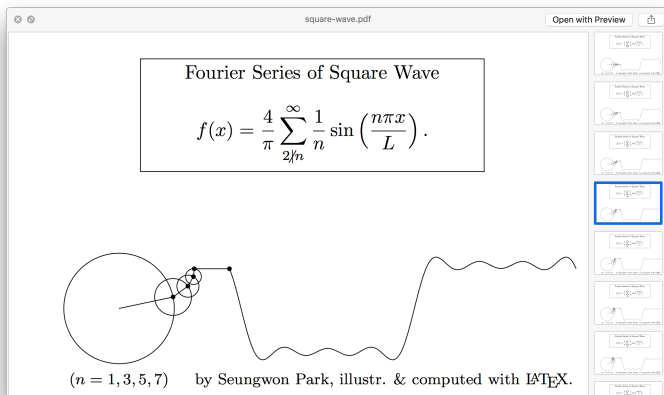
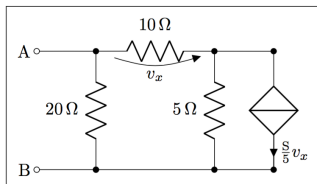


Image: [i.imgur.com/l3GFf15.gif](https://i.imgur.com/l3GFf15.gif) / Source: [git.io/vHrAL](https://git.io/vHrAL)

# circuitikz

- ▶ circuitikz package for circuit drawing
- ▶ No more annoying mouse-clicking!
- ▶ > `texdoc circuitikz`

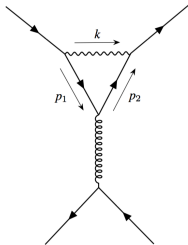


```
1 \begin{circuitikz}[scale=1.2]\draw
2 (0,0) node[anchor=east] {B}
3   to[short, o-*] (1,0)
4   to[R=20<\ohm>, **] (1,2)
5   to[R=10<\ohm>, v=$v_x$] (3,2) -- (4,2)
6   to[cI=$\frac{\siemens}{5} v_x$, **] (4,0) -- (3,0)
7   to[R=5<\ohm>, **] (3,2)
8 (3,0) -- (1,0)
9 (1,2) to[short, -o] (0,2) node[anchor=east]{A}
10 \end{circuitikz}
```



# tikz-feynman

- ▶ Drawing Feynman diagrams with TikZ
- ▶ `> texdoc tikz-feynman`



```
\feynmandiagram [large, vertical=e to f] {
  a -- [fermion] b -- [photon, momentum=\(k\)] c -- [fermion] d,
  b -- [fermion, momentum'=\(p_{(1)}\)] e -- [fermion, momentum'=\(p_{(2)}\)] c,
  e -- [gluon] f,
  h -- [fermion] f -- [fermion] i;
};
```

- ▶ File - Export - Graphics View as PGF/TikZ
  - ▶ If you don't need a vector graphic, just do a screenshot!

The screenshot shows the GeoGebra interface with a triangle in the Graphics View. The Algebra View on the left lists the following objects:

- Point
  - A = (1.56, 4.16)
  - B = (0.42, -0.24)
  - C = (4.62, 1.96)
- Segment
  - a = 4.74
  - b = 3.77
  - c = 4.55
- Triangle
  - poly1 = 7.99

The 'GeoGebra to PGF Export' dialog box is open on the right, with the following settings:

- X units (cm): 1.0
- Y units (cm): 1.0
- Picture width: 21.2
- Picture height: 11.5399999999
- x Min: -4.3
- x Max: 16.9
- y Min: -5.2399999999
- y Max: 6.2999999999
- Document font size: 10 pt
- Format: LaTeX (article class)
- Use Gnuplot to plot functions
- Display the symbol for points
- Grayscale

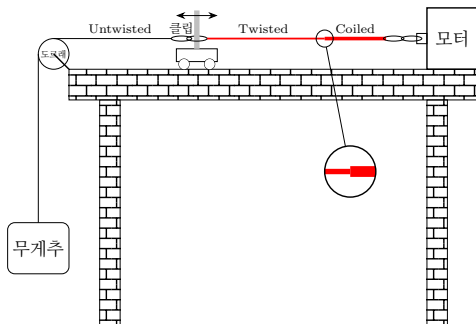
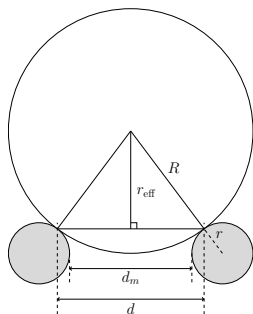
The 'Generate PGF/TikZ code' button is highlighted. The resulting LaTeX code is shown in a text area at the bottom of the dialog:

```

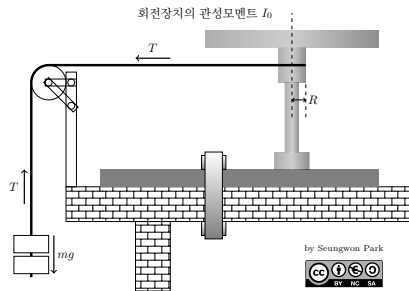
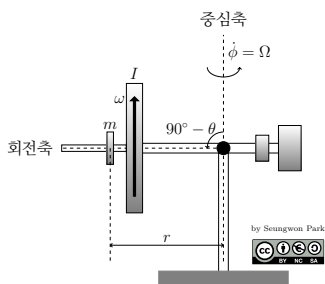
\documentclass[10pt]{article}
\usepackage{pgf,tikz}
\usepackage{mathrsfs}
\usetikzlibrary{arrows}
\pagestyle{empty}
\begin{document}
\definecolor{zzttqq}{rgb}{0.6,0.2,0.}
\definecolor{qqqqff}{rgb}{0.,0.,1.}
\begin{tikzpicture}[line cap=round,line join=round,>=triangle 45,x=1.0cm,y=1.0cm]
\clip(-4.3,-5.24) rectangle (16.9,6.3);
\fill[line width=1.2pt,color=zzttqq,fill=zzttqq,fill opacity=0.10000000149011612]
\draw [line width=1.2pt,color=zzttqq] (1.56,4.16)-- (0.42,-0.24);

```

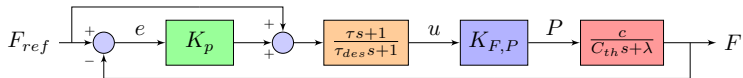
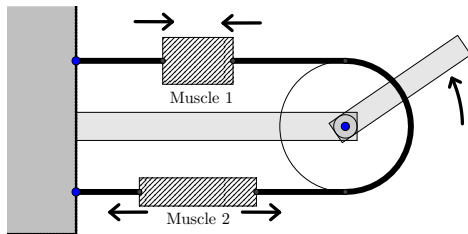
- Some simple examples.



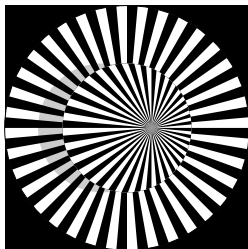
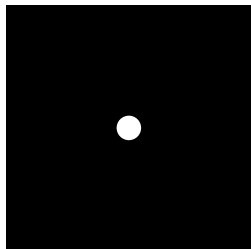
- Some examples: From my physics lab. course report



- Some examples: From my high-school R&E



- ▶ Some examples: My profile pictures



## Some tips on using TikZ

- ▶ Use `standalone` class and make single image file.
  - ▶ Helpful for reducing compilation time
- ▶ If compiling time  $\rightarrow \infty$ , perhaps you've missed semicolon `;`.
- ▶ For various usage, have a look at `texample.net`.

# Pros/Cons of using TikZ




- ▶ Pros:
  - ▶ Free.
  - ▶ Good for drawing simple(but important) figures.
  - ▶ Enables repetitive job.
  - ▶ Lots of science-related packages.
  - ▶ Again, no mouse-clicking required.
- ▶ Cons:
  - ▶ Quite annoying to set coordinates.
  - ▶ ... plus, common weak points of WYSIWYM.



# Conclusion

- ▶ 'Standard' graphing tool: Excel, matplotlib, R, ...
  - ▶ R also helps plot reverse-engineering(?).
- ▶ TikZ is the best drawing tool among free software.
  - ▶ Try using TikZ for drawing figures.
- ▶ 표현 수단의 확대 → 표현의 확대 → 생각의 확대
  - ▶ *Cited from [3].*

# References

-  TikZ& PGF Manual for Version 3.0.1a
-  Joshua Ellis. 'TikZ-Feynman: Feynman diagrams with TikZ'.  
arXiv: 1601.05437 [hep-ph]
-  윤석천 (2015)  $\text{\LaTeX}$  쉽게 쓰기 : <http://bit.ly/2tXsRgi>