Graphing/Drawing Tools for Physics Research

Especially, Ti*k*Z.

Seungwon Park

`http://swpark.me`

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Graphing - popular tools

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  - 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}) $};
}
```
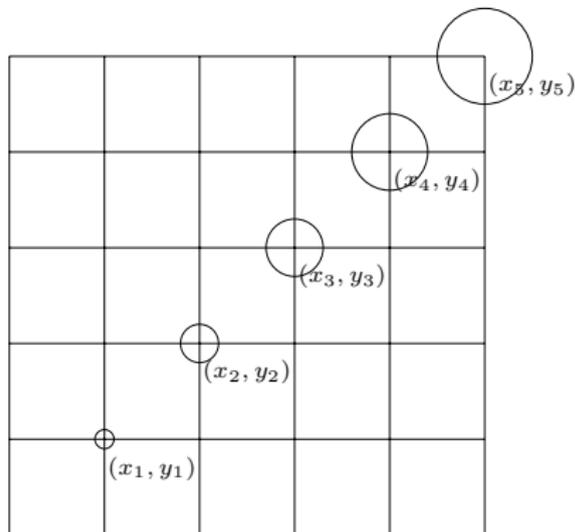
Drawing animation with Ti*k*Z

Fourier Series of Square Wave

$$f(x) = \frac{4}{\pi} \sum_{2\nmid n}^{\infty} \frac{1}{n} \sin\left(\frac{n\pi x}{L}\right).$$

$(n = 1, 3, 5, 7)$ by Seungwon Park, illustr. & computed with LaTeX.
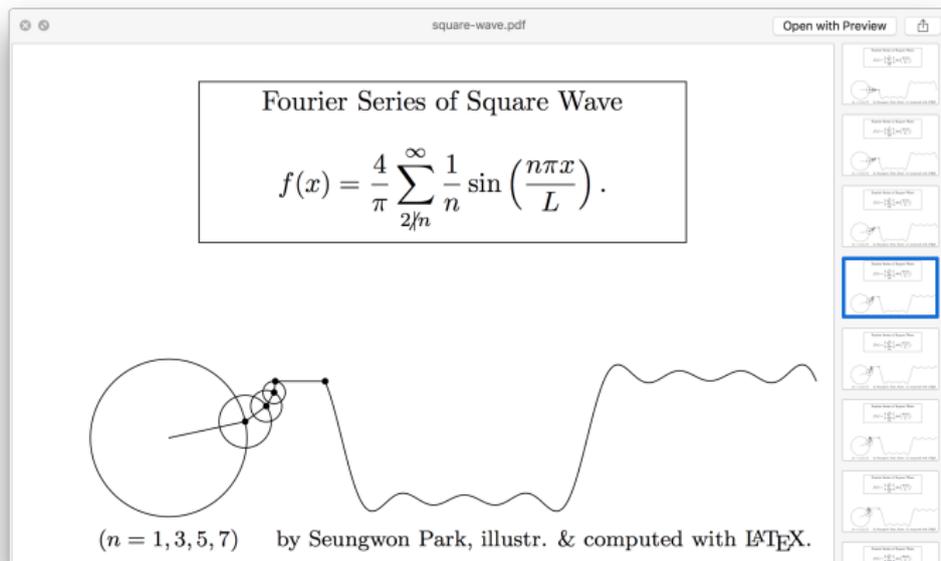
Image: `i.imgur.com/l3GFf15.gif` / Source: `git.io/vHrAL`

circuitikz

- `circuitikz` package for circuit drawing

- No more annoying mouse-clicking!

- `> texdoc circuitikz`
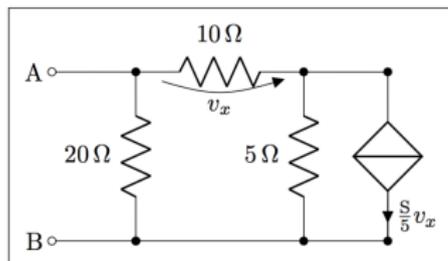

```
1 \begin{circuitikz}[scale=1.2]\draw
2 (0,0) node[anchor=east] {B}
3     to[short, o-*] (1,0)
4     to[R=20<\ohm>, *-*] (1,2)
5     to[R=10<\ohm>, v=$v_x$] (3,2) -- (4,2)
6     to[cI=$\frac{\siemens}{5} v_x$, *-*] (4,0) -- (3,0)
7     to[R=5<\ohm>, *-*] (3,2)
8 (3,0) -- (1,0)
9 (1,2) to[short, -o]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

tikz-feynman

- Drawing Feynman diagrams with Ti*k*Z

- `> texdoc tikz-feynman`
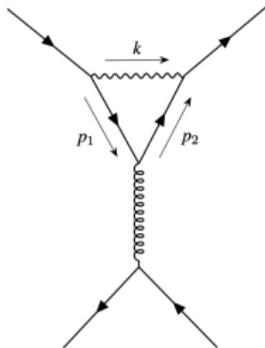

```
\feynmandiagram [large, vertical=e to f] {
  a -- [fermion] b -- [photon, momentum=\(k\)] c -- [fermion] d,
  b -- [fermion, momentum'=\(p_{1}\)] e -- [fermion, momentum'=\(p_{2}\)] c,
  e -- [gluon] f,
  h -- [fermion] f -- [fermion] i;
};
```

GeoGebra

▶ `File - Export - Graphics View as PGF/TikZ`

   ▶ If you don't need a vector graphic, just do a screenshot!

TikZ

▶ Some simple examples.

TikZ

- Some examples: From my physics lab. course report
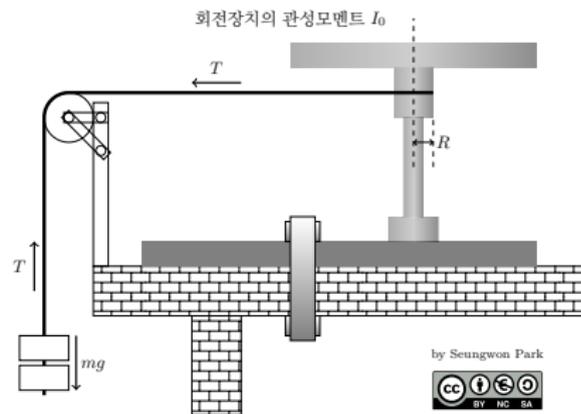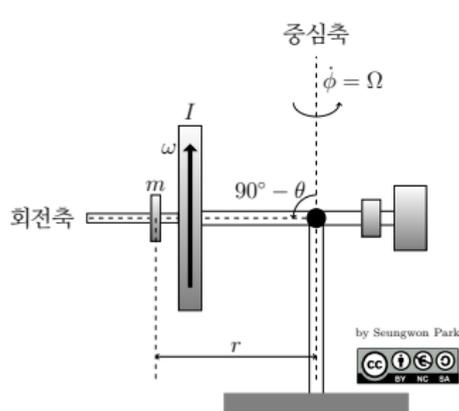
TikZ

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

$$F_{ref} \xrightarrow{} \underset{-}{\overset{+}{\bigcirc}} \xrightarrow{\;e\;} \boxed{K_p} \xrightarrow{} \underset{+}{\overset{+}{\bigcirc}} \xrightarrow{} \boxed{\frac{\tau s+1}{\tau_{des}s+1}} \xrightarrow{\;u\;} \boxed{K_{F,P}} \xrightarrow{\;P\;} \boxed{\frac{c}{C_{th}s+\lambda}} \xrightarrow{\;F\;}$$
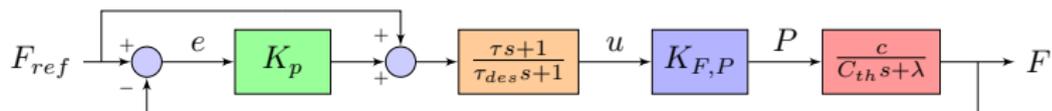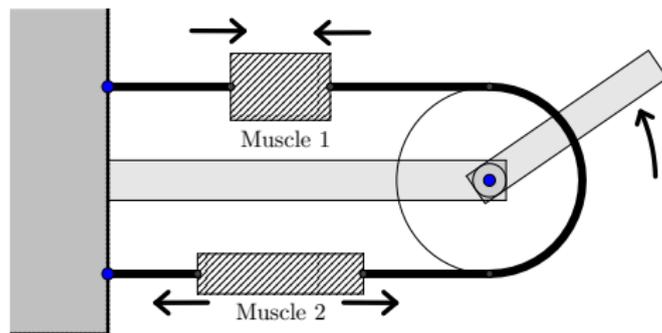
TikZ

▶ Some examples: My profile pictures
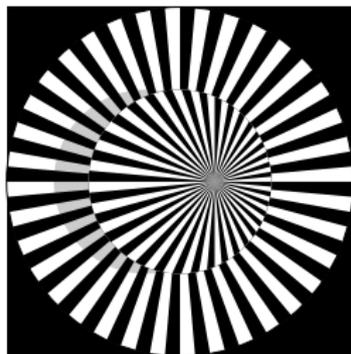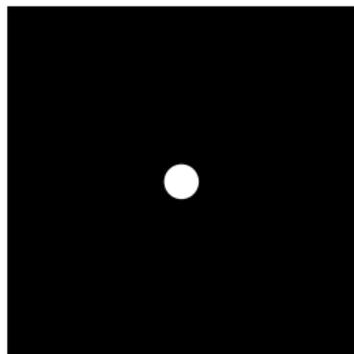
Some tips on using TikZ

- ► 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(?).
- Ti*k*Z is the best drawing tool among free software.
    - Try using Ti*k*Z for drawing figures.
- 표현 수단의 확대 → 표현의 확대 → 생각의 확대
    - *Cited from [3].*

References

📄 Ti*k*Z& PGF Manual for Version 3.0.1a

📄 Joshua Ellis. 'TikZ-Feynman: Feynman diagrams with TikZ'.
   arXiv: 1601.05437 [hep-ph]

📄 윤석천 (2015) LaTeX 쉽게 쓰기 : `http://bit.ly/2tXsRgi`