The LaTeX mini-guide

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Chapter 1

Mathematics – The "mathtools" package

Mathematics writing is one of the most advantage of LaTeX compared to common text editors. On a first approach, it looks like a programming language but it is in fact quite intuitive.

The first package which was extremely useful in mathematics writing was `amsmath`. Since then, it has been upgraded by the `mathtools` package that I recommend to use.

1.1 Writing an equation

Writing an equation is simply done thanks to the `equation` environment. Maxwell's equations will be used as examples. So, the

```
\begin{equation}
    \vec{\nabla}\cdot\vec{B}=0.
    \label{eq::Maxwell:no_magnetic_monopole}
\end{equation}
```

LaTeX code generates

$$\vec{\nabla}\cdot\vec{B}=0. \tag{1.1}$$

1.1.1 Unnumbered equations

Automatic numbering can be avoided by using the starred version: `equation*`. For instance,

```
\begin{equation*}
    \vec{\nabla}\times\vec{E}
        =-\frac{\partial\vec{B}}{\partial t}.
\end{equation*}
```

produces

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}.$$

Nevertheless, it is generally recommended to number all equations in scientific documents for easier reference.

Shorter forms of the unnumbered version are offered by the package: the \[...\] wrapper or the double $$ symbol. Please note that the latter is plain TEX, which means that it should not be used with LaTeX because it is not robust.

Here follow the corresponding examples:

```
$$\iint_{\Sigma_f} \vec{B} \cdot \mathrm{d}\vec{S},$$
```

is the code corresponding to

$$\iint_{\Sigma_f} \vec{B} \cdot \mathrm{d}\vec{S},$$

while

```
\[ \oint_{C} \vec{E} \cdot \mathrm{d}\vec{l}
     = - \iint_{S} \frac{\partial\vec{B}}{\partial t}
       \cdot \mathrm{d}\vec{S}. \]
```

creates

$$\oint_{C} \vec{E} \cdot \mathrm{d}\vec{l} = - \iint_{S} \frac{\partial \vec{B}}{\partial t} \cdot \mathrm{d}\vec{S}.$$

However, I do not recommend to use them. On the one hand, the `equation*` environment highlights the mathematics when looking in the LATEX code. On the other hand, if the author changes his mind and wants to number the equation, he must simply remove the `*` character.

1.1.2 Inline equations

Inline equations are equations written in the text. It can be useful in some circumstances, such as the description of a variable. For instance, I could specify that $\vec{B}$ in eq. (1.1) is the magnetic field. To do so, the equation is surrounded by single $ signs:

```
$\vec{B}$
```

Unfortunately, inline equations may introduce unpleasant distortion in the text, especially with “big” symbols. As an example, let us use express the acceleration as the derivative of the speed: $a = \frac{\mathrm{d}v}{\mathrm{d}t}$. It can be seen that the fraction symbol has been compacted to fit with the line space.

It is possible to prevent the fraction from being reshaped by forcing the *math*-mode. To do so, the writer must use the `displaystyle` command, which exists in shorter forms for common mathematical symbols such as fractions. Expressing again the acceleration: $a = \frac{\mathrm{d}v}{\mathrm{d}t}$, or, equivalently, $a = \dfrac{\mathrm{d}v}{\mathrm{d}t}$. It can be seen that the space line is increased above and below the line including the equation, creating a somewhat uncomfortable text arrangement.

The problem presented here above is related to the following LaTeX codes:

```
$a=\frac{\mathrm{d}v}{\mathrm{d}t}$
```

```
$a=\dfrac{\mathrm{d}v}{\mathrm{d}t}$
```

```
$\displaystyle a=\frac{\mathrm{d}v}{\mathrm{d}t}$
```

1.1.3 General recommendations for equations

Recommendations:

- use numbered equation only (with the `equation` environment),
- try to avoid inline equations except
  - to describe variables or operators,
  - for very small, less important formulae which do not contain “big” symbols (e.g., integral, fraction).

Part III

LaTeX for advanced users