Mathematics

Basics

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Overview

Packages for mathematics

Some packages very useful for mathematics are listed here below:

- the very well-known *amsmath* package which is the backbone for mathematics with LaTeX,
- *mathtools* which is mainly an upgrade of *amsmath*,
- *cases* which provides the `numcases` command to number all lines of a system of equations (cf. tutorial C100),
- *systeme* which provides command to format a system of equations for better readility (cf. tutorial C100), and
- *physics* which provides many commands to facilitate the writing of "complex" equations including derivatives and partial derivatives (cf. tutorial C102).

Equations

Main environment for mathematics

The main LaTeX's environment to write an equation is... `equation`. As an example:

$$\vec{\nabla} \cdot \vec{B} = 0 \tag{1}$$

The starred version (`equation*`) disables numbering:

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

There are also shorter forms:

- the \[...\] wrapper surrounding the equation,
- the double $$ symbol surrounding the equation (still overly used but it is plain TeX and should not be used).

Recommendation: use `equation` instead of the short forms:

- it highlights the mathematics in the LaTeX code,
- versatility between the numbered and the unnumbered version.

Equations

Inline equations – text-mode & math-mode

Need: it is sometimes useful to write mathematics inside a text, for instance to describe the variable $\vec{B}$ appearing in eq. (1). To do so, the mathematical formula must be wrapped by single $ signs.
Inline equations underlines a fundamental behaviour of LaTeX: the difference between math-mode and text-mode. Compare:

- regular text (text-mode),
- *textinmathematicalenvironment* (math-mode).

Know the mode inside an environment to understand how LaTeX will behave.
Recommendation: use inline equations only

- to express a variable,
- for a very short and well-known formula that must not be referred and that do not contain big symbols (integral, sum, etc.).

Grouping equations

No alignment inside the group

Tool: `gather` environment, double backslash (\\) before starting a new equation.
Example with the local equation from Ampere theorem:

$$\vec{\nabla} \times \vec{B} = \mu_0 \vec{\jmath} + \varepsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}, \tag{2}$$

which can be written in the integral form by applying the Green theorem

$$\oint_C \vec{B} \cdot \mathrm{d}\vec{l} = \mu_0 \iint_S \vec{\jmath} \cdot \mathrm{d}\vec{S} + \varepsilon_0 \mu_0 \iint_S \frac{\partial \vec{E}}{\partial t} \cdot \mathrm{d}\vec{S}. \tag{3}$$

Extra: text can be written between equations thanks to the `intertext` and `shortintertext` commands. LaTeX is in text-mode within these commands and in math-mode within the rest of the `gather` environment.

Grouping equations

Alignment inside the group

Tool: `align` environment, double backslash (\\) before starting a new equation, ampersand (&) to indicate where the alignment is performed. Examples with the vector potential:

$$\vec{B} = \vec{\nabla} \times \vec{A} \tag{4}$$

$$\vec{E} = -\vec{\nabla} V - \frac{\partial \vec{A}}{\partial t} \tag{5}$$

Extra: the `intertext` and `shortintertext` commands are also available. The alignment is generally performed on the equal sign.

Common symbols for mathematics

Mathematics would not be mathematics without any symbols. As there is no point to show an exhaustive list of existing mathematical symbols in this tutorial, here follows a list of references:

- your LaTeX editor, which generally provides a list of shortcuts and buttons to generate the correct commands,
- a quick review of symbols from ShareLaTeX,
- a big list of symbols native from TeX and coming from different packages.