LaTeX Mathematics Examples

Prof Tony Roberts

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1 Delimiters

See how the delimiters are of reasonable size in these examples

$$(a+b)\left[1-\frac{b}{a+b}\right]=a\,,$$

$$\sqrt{|xy|} \le \left| \frac{x+y}{2} \right| ,$$

even when there is no matching delimiter

$$\int_a^b u \frac{d^2v}{dx^2} dx = u \frac{dv}{dx} \Big|_a^b - \int_a^b \frac{du}{dx} \frac{dv}{dx} dx \, .$$

2 Spacing

Integrals often need a bit of help with their spacing as in

$$\iint xy^2 \, dxdy = \frac{1}{6} x^2 y^3 \, ,$$

whereas vector problems often lead to statements such as

$$u = \frac{-y}{x^2+y^2} \, , \quad v = \frac{x}{x^2+y^2} \, , \quad \text{and} \quad w = 0 \, .$$

3 Arrays

Arrays of mathematics are typeset using a tabular like environment as in

$$\begin{bmatrix} 1 & x & 0 \\ 0 & 1 & -1 \end{bmatrix} \begin{bmatrix} 1 \\ y \\ 1 \end{bmatrix} = \begin{bmatrix} 1+xy \\ y-1 \end{bmatrix} ,$$

or in a case statement such as

$$|x| = \begin{cases} x & \text{if } x \ge 0 \\ -x & \text{if } x < 0 \end{cases}$$

Many arrays have lots of dots all over the place as in

$$\begin{bmatrix} -2 & 1 & 0 & 0 & \cdots & 0 \\ 1 & -2 & 1 & 0 & \cdots & 0 \\ 0 & 1 & -2 & 1 & \cdots & 0 \\ 0 & 0 & 1 & -2 & \ddots & \vdots \\ \vdots & \vdots & \vdots & \ddots & \ddots & 1 \\ 0 & 0 & 0 & \cdots & 1 & -2 \end{bmatrix}$$

4 Equation arrays

In the flow of a fluid film we may report

$$\begin{aligned} u_\alpha &= \epsilon^2 \kappa_{xxx} \left(y - \frac{1}{2} y^2 \right) , && (1) \\ v &= \epsilon^3 \kappa_{xxx} y \, , && (2) \\ p &= \epsilon \kappa_{xx} \, . && (3) \end{aligned}$$

Alternatively, the curl of a vector field (u, v, w) may be written with only one equation number:

$$\begin{aligned} \omega_1 &= \frac{\partial w}{\partial y} - \frac{\partial v}{\partial z} \, , \\ \omega_2 &= \frac{\partial u}{\partial z} - \frac{\partial w}{\partial x} \, , \\ \omega_3 &= \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y} \, . \end{aligned} \qquad (4)$$

Whereas a derivation may look like

$$\begin{aligned} (p \wedge q) \vee (p \wedge \neg q) &= p \wedge (q \vee \neg q) \quad \text{by distributive law} \\ &= p \wedge T \qquad \text{by excluded middle} \\ &= p \qquad \text{by identity} \end{aligned}$$

5 Functions

Observe that trigonometric and other elementary functions are typeset properly, even to the extent of providing a thin space if followed by a single letter argument:

$$\exp(i\theta) = \cos\theta + i\sin\theta\,, \quad \sinh(\log x) = \frac{1}{2}\left(x - \frac{1}{x}\right)\,.$$

With sub- and super-scripts placed properly on more complicated functions,

$$\lim_{q\to\infty} \|f(x)\|_q = \max_x |f(x)|\,,$$

and large operators, such as integrals and

$$\begin{aligned} e^x &= \sum_{n=0}^{\infty} \frac{x^n}{n!} \quad \text{where } n! = \prod_{i=1}^{n} i\,, \\ \overline{U_\alpha} &= \bigcap_\alpha U_\alpha\,. \end{aligned}$$

Although in inline mathematics the scripts are placed to the side in order to conserve vertical space, as in $1/(1-x) = \sum_{n=0}^{\infty} x^n$.

6 Accents

Mathematical accents are performed by a short command with one argument, such as

$$\tilde{f}(\omega) = \frac{1}{2\pi}\int_{-\infty}^{\infty} f(x)e^{-i\omega x}\,dx\,,$$

or

$$\dot{\vec{\omega}} = \vec{r}\times\vec{I}\,.$$

7 Command definition

The Airy function, $\mathrm{Ai}(x)$, may be incorrectly defined as this integral

$$\mathrm{Ai}(x) = \int \exp(s^3 + isx)\, ds\,.$$

This vector identity will serve nicely to illustrate two of the new commands:

$$\boldsymbol{\nabla} \times \boldsymbol{q} = \boldsymbol{i}\left(\frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}\right) + \boldsymbol{j}\left(\frac{\partial u}{\partial z} - \frac{\partial w}{\partial x}\right) + \boldsymbol{k}\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)\,.$$