Elegant derivatives: `derivatives`

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1 Introduction

This package simply wraps some commonly-used commands to typeset derivatives like $\mathrm{d}^2y/\mathrm{d}x^2$, $\partial^4v/\partial x^4$, and $\mathrm{D}\rho/\mathrm{D}t$.

2 Usage

If we want to typeset a total derivative, like $\mathrm{d}y/\mathrm{d}x$, we simply type `\tderiv{y}{x}` in math mode, similar to `\pderiv{u}{t}` for $\partial u/\partial t$ and `\mderiv{\rho}` for $\mathrm{D}\rho/\mathrm{D}t$. If we want a higher order derivative, just add a `[⟨order⟩]` in front of the function, like `\pderiv[2]{u}{t}` to obtain $\partial^2u/\partial t^2$. If we want to typeset derivatives in a displayed equation, just do it as we do in an inline equation, and the package will handle that. For example, `c^2 \pderiv[2]{u}{x} = \pderiv[2]{u}{t}` gives

$$c^2\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2} \tag{1}$$

instead of

$$c^2\,\partial^2u/\partial x^2 = \partial^2u/\partial t^2. \tag{2}$$

But what should be noticed is that `\tderiv{y}{x}` is slightly different from `\tderiv[]{y}{x}`, shown in Table 1. And the former is recommended.

Table 1: Difference between with and without empty `[]`.

Command	Result
`$\tderiv{y}{x}$`	$\mathrm{d}y/\mathrm{d}x$
`$\tderiv[]{y}{x}$`	$\mathrm{d}y/\mathrm{d}x$

3 Remark

Since `xparse` is used in the package, although the user don't have to explicitly import the package, it must be installed. If TeX Live is being used, `tlmgr install l3packages` can be used to install the required package.

4 Implementation

As we mentioned earlier, `xparse` is used in the package.

```
1 ⟨∗package⟩
2 \usepackage{xparse}
```

`\tderiv@t` `\tderiv@t` is the total derivative command in inline math mode, or style T in Chapter 17, Knuth [1]. `\mathop{} \!` is added to make axtra spaces between the derivative and any other symbol in front of the derivative, and it vanishes if there's no symbol before that[1]. Just refer to Table 2 to see the difference.

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[1]See https://liam.page/2017/05/01/the-correct-way-to-use-differential-operator/.

Table 2: Difference between with and without `\mathop{}` `\!`.

Command	Result
`$2 \tderiv{y}{x}$`	$2\,\mathrm{d}y/\mathrm{d}x$
`$2 \, \mathrm{d} y / \mathrm{d} x$`	$2\,\mathrm{d}y/\mathrm{d}x$
`$2 \mathrm{d} y / \mathrm{d} x$`	$2\mathrm{d}y/\mathrm{d}x$

```
3 \DeclareRobustCommand\tderiv@t[3]{%
4   \IfNoValueTF{#1}{%
5     \mathop{} \! \mathrm{d} #2{} / \mathrm{d} {#3}%
6   } {%
7     \mathop{} \! \mathrm{d}^{#1} #2{} / \mathrm{d} {#3}^{#1}%
8   }%
9 }
```

\tderiv@d   \tderiv@d is the total derivative command in display math mode, or style D.

```
10 \DeclareRobustCommand\tderiv@d[3]{%
11   \IfNoValueTF{#1}{%
12     \frac{\mathrm{d} #2{}}{\mathrm{d} {#3}}%
13   } {%
14     \frac{\mathrm{d}^{#1} #2{}}{\mathrm{d} {#3}^{#1}}%
15   }%
16 }
```

\tderiv   \tderiv is the interface to typeset the total derivative. \mathchoice is used here to choose a proper form of 'fraction', *loc cit*. If in style S or SS, nothing will be typeset.

```
17 \NewDocumentCommand\tderiv{omm}
18   {\mathchoice{\tderiv@d{#1}{#2}{#3}}{\tderiv@t{#1}{#2}{#3}}{}{}}
```

\pderiv@t   \pderiv@t is the partial derivative command in inline math mode.

```
19 \DeclareRobustCommand\pderiv@t[3]{%
20   \IfNoValueTF{#1}{%
21     \mathop{} \! \partial #2{} / \partial {#3}%
22   } {%
23     \mathop{} \! \partial^{#1} #2{} / \partial {#3}^{#1}%
24   }%
25 }
```

\pderiv@d   \pderiv@d is the total derivative command in display math mode.

```
26 \DeclareRobustCommand\pderiv@d[3]{%
27   \IfNoValueTF{#1}{%
28     \frac{\partial #2{}}{\partial {#3}}%
29   } {%
30     \frac{\partial^{#1} #2{}}{\partial {#3}^{#1}}%
31   }%
32 }
```

\pderiv   \pderiv is the interface to typeset the partial derivative.

```
33 \NewDocumentCommand\pderiv{omm}
34   {\mathchoice{\pderiv@d{#1}{#2}{#3}}{\pderiv@t{#1}{#2}{#3}}{}{}}
```

\mderiv@t   \mderiv@t is the material derivative command in inline math mode.

```
35 \DeclareRobustCommand\mderiv@t[2]{%
36   \IfNoValueTF{#1}{%
37     \mathop{} \! \mathrm{D} #2{} / \mathrm{D} t%
38   } {%
39     \mathop{} \! \mathrm{D}^{#1} #2{} / \mathrm{D} t^{#1}%
40   }%
41 }
```

<dl>
<dt>\mderiv@d</dt>
<dd>\mderiv@d is the material derivative command in display math mode.</dd>
</dl>

```
42 \DeclareRobustCommand\mderiv@d[2]{%
43   \IfNoValueTF{#1}{%
44     \frac{\mathrm{D} #2{}}{\mathrm{D} t}%
45   } {%
46     \frac{\mathrm{D}^{#1} #2{}}{\mathrm{D} t^{#1}}%
47   }%
48 }
```

<dl>
<dt>\mderiv</dt>
<dd>\mderiv is the interface to typeset the material derivative.</dd>
</dl>

```
49 \NewDocumentCommand\mderiv{om}
50   {\mathchoice{\mderiv@d{#1}{#2}}{\mderiv@t{#1}{#2}{}{}}
```

<dl>
<dt>\xderiv@t</dt>
<dd>\xderiv@t is the derivative command in inline math mode.</dd>
</dl>

```
51 \DeclareRobustCommand\xderiv@t[4]{%
52   \IfNoValueTF{#2}{%
53     #1{} #3{} / #1{} #4{}%
54   } {%
55     {#1}^{#2} #3{} / #1{} {#4}^{#2}%
56   }%
57 }
```

<dl>
<dt>\xderiv@d</dt>
<dd>\xderiv@d is the derivative command in display math mode.</dd>
</dl>

```
58 \DeclareRobustCommand\xderiv@d[4]{%
59   \IfNoValueTF{#2}{%
60     \frac{#1{} #3{}}{#1{} #4{}}%
61   } {%
62     \frac{{#1}^{#2} #3{}}{#1{} {#4}^{#2}}%
63   }%
64 }
```

<dl>
<dt>\xderiv</dt>
<dd>\xderiv is the interface to typeset any kind of derivative.</dd>
</dl>

```
65 \NewDocumentCommand\xderiv{momm}
66   {\mathchoice{\xderiv@d{#1}{#2}{#3}{#4}}{\xderiv@t{#1}{#2}{#3}{#4}}{}{}}
```

```
67 ⟨/package⟩
```

References

[1]   KNUTH D E. The TeXbook[M]. Addison-Wesley, 1984.

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Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.

Change History