

The package **EASYEQN**

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Abstract

The package **EASYEQN** introduces some equation environments that simplify the typesetting of equations. It uses a syntax similar to the `array` environment to define the column alignment. The label field is fully customizable. A package option permits to number only those equations that were *labeled and referenced*. Additional macros are also included to facilitate the typing of formulae.

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1 Some examples with **EASYEQN**

The package is loaded by means of the usual syntax:

```
\documentclass{article}
.
.
\usepackage[allnumber,warning, easyold,
            fleqn,leqno,math]{easyeqn}
.
.
```

The package¹ introduces the **EQ** and **EQA** environments. The package options are:

allnumber Means that all of the **EQ** and **EQA** environments are numbered. Without that option, only those **EQ** and **EQA** environments that are explicitly *labeled* and *referenced* are numbered.

warning Causes the flagging of the equations that are labeled but *not referenced*.

easyold Produces obsolete environment **EQS**, **EQS***, **EQ***, **EQA*** for backward compatibility.

fleqn equations will be left-justify.

leqno Writes equation number on the left.

math Defines additional macros for mathematics.

2 Use of the **EQ** environment

The use of **EQ** environment is best understood by the following example:

¹the option “showkeys” is eliminated because the new release of **EASYEQN** is compatible with the **SHOWKEYS** package

```

\begin{EQ}\label{eq:1}
  \frac{x}{y} = z
\end{EQ}
\begin{EQ}\label{eq:2}
  \frac{a}{b} = c
\end{EQ}
I will refer only to \eqref{eq:1} or,
in the old style, \refeq{eq:1}.

```

$$\frac{x}{y} = z \tag{1}$$

$$\frac{a}{b} = c$$

I will refer only to (1) or, in the old style, 1.

Note that the reference is done by `\eqref` or `\refeq`. The command `\refeq` produces the same output as `\ref`, while `\eqref` uses () for the output.

Remark: Due to the algorithm implementation, in order to obtain the right cross reference, you need to recompile the file 3 times. The use of `\label` is not permitted from within **EQ*** environments. If you use `\ref` to reference equations results are unpredictable².

Here is another example:

```

\begin{EQ}[rcll]
  \nabla\cdot(\rho\nabla u) \mathrel{=}\! f \quad \text{\rm on } \Omega
  \quad \mathrel{=}\! \text{\rm on } \Omega
  \quad \mathrel{=}\! \text{\rm on } \Omega
  \quad \mathrel{=}\! \text{\rm on } \Omega
  \quad \mathrel{=}\! \text{\rm on } \Omega
\end{EQ}

```

$$\begin{aligned} \nabla \cdot (\rho \nabla u) &= f && \text{on } \Omega \\ u &= u_0 && \text{on } A \subset \partial\Omega \\ (\rho \nabla u) \cdot n &= u_1 && \text{on } B \subset \partial\Omega \end{aligned}$$

²The previous release used the command `eqlabel` for equation labelling, for backward compatibility this command is maintained but the user should use the `label` command

Note that between **[...]** you can specify the column alignment in the same way as in the **array** or **tabular** environment³. The permitted alignment are **l** for left alignment, **r** for right alignment and **c** for centering. There is also the character “.” that if used between the definition of two columns, disables the spacing between columns as in the following example, which is taken from the documentation of **EQNARRAY** of Roland Winkler;

```
\begin{EQ}[rcl.1]
  \phi & = & \sum \bigg( & \frac{xxxxxxxx}{\phi} \\
        & & + \frac{yyyyyyyy}{\phi} \bigg) \\
  & = & \eqmulticol{2}{l}
        {\frac{zzzzzzzz}{\phi}}
\end{EQ}
```

$$\begin{aligned}\phi &= \sum \left(\frac{xxxxxxxx}{\phi} \right. \\ &\quad \left. + \frac{yyyyyyyy}{\phi} \right) \\ &= \frac{zzzzzzzz}{\phi}\end{aligned}$$

In the above example the command `\eqmulticol` has been introduced. Its syntax is:

```
\eqmulticol{ncol}{align}{body}
```

where:

ncol number of column to merge.

aling alignment, parameter to be chosen among the set **l**, **r**, **c**.

body expression to put across the column.

3 The `\yesnumber` command

If may you want to number an equation without reference it. The `\yesnumber` command does the work as this example shows:

³In a previous release of **EASYEQN** multicolumn alignment was implemented in a **EQS** environment. However to keep backward compatibility such an environment is maintained

```
\begin{EQ}[rcl]\yesnumber
  a & = & \frac{1}{23} \\
  b & = & \sqrt{\frac{1}{23}}
\end{EQ}
```

$$\begin{aligned} a &= \frac{1}{23} \\ b &= \sqrt{\frac{1}{23}} \end{aligned} \tag{2}$$

4 Use of **EQA** environment

```
\begin{EQA}[rcll]
  \nabla\!\cdot\!(\rho\nabla u) &= & f \quad \text{\mbox{on } $\Omega$} \\
  \yesnumber \\
  u &= u_0 \quad \text{\mbox{on } $A \subset \partial\Omega$} \\
  \label{eq:3} \\
  (\rho\nabla u) \cdot n &= u_1 \quad \text{\mbox{on } $B \subset \partial\Omega$} \\
  \label{eq:4}
\end{EQA}
it is referenced only \eqref{eq:4}!!
```

$$\nabla \cdot (\rho \nabla u) = f \quad \text{on } \Omega \tag{3}$$

$$u = u_0 \quad \text{on } A \subset \partial\Omega$$

$$(\rho \nabla u) \cdot n = u_1 \quad \text{on } B \subset \partial\Omega \tag{4}$$

it is referenced only (4)!!

Note that only the referenced lines or the lines with `\yesnumber` are numbered.

5 The `\label` command

It is possible to use custom label by `\label` command. The syntax is one of the following:

```

\label{labelname}
\label[eqnum]
\label[eqnum]{labelname}
\label(eqnum)
\label(eqnum){labelname}

```

where **[eqnum]** is an optional argument that if defined, causes the equation displays **eqnum** instead of **(equation number)**. The equation counter is not advanced and **labelname** if present will refer to **eqnum**.

For example:

```

\begin{EQA}[c]
  \nabla\cdot(\rho\nabla u) = 0
  \label(eq.1){eq:custom:a} \\
  \nabla\cdot(\rho\nabla u) = 0
  \label(eq.2){eq:custom:b} \\
  \nabla\cdot(\rho\nabla u) = 0
  \label[***1***]
\end{EQA}
I will refer to \eqref{eq:custom:a}
and \eqref{eq:custom:b}

```

$$\nabla \cdot (\rho \nabla u) = 0$$

$$\nabla \cdot (\rho \nabla u) = 0$$

$$\nabla \cdot (\rho \nabla u) = 0$$

(eq.1)
 eq.2
 1

I will refer to (eq.1) and (eq.2)

Note that custom label are always displayed even if not referenced.

6 Label positioning

It is possible to change the default position of a single label by the commands:

- `\eqlabeltop`
- `\eqlabelbot`
- `\eqlabelcenter`

For example:

```

\eqlabeltop
\begin{EQ}\label{TOP}
    \nabla\cdot(\rho\nabla u) = 0 \ \
    \nabla\cdot(\rho\nabla u) = 0
\end{EQ}
*****
\eqlabelbot
\begin{EQ}\label{BOT}
    \nabla\cdot(\rho\nabla u) = 0 \ \
    \nabla\cdot(\rho\nabla u) = 0
\end{EQ}

```

$\nabla \cdot (\rho \nabla u) = 0$	TOP
$\nabla \cdot (\rho \nabla u) = 0$	

$\nabla \cdot (\rho \nabla u) = 0$	
$\nabla \cdot (\rho \nabla u) = 0$	BOT

7 Sub-numbering

To sub-number equation, instead of use something like

```

\begin{subequations}
\begin{EQ}...

\end{EQ}
\end{subequations}

```

I prefer to use the `\label` command with the character `~` as a shortcut for the command `\theequation`. The following example shows the use:


```

\begin{EQA}[c]\yesnumber
  \nabla\cdot(\rho\nabla u) = 0 \label{~.A} \\
  \nabla\cdot(\rho\nabla u) = 0 \label{~.B} \\
  \nabla\cdot(\rho\nabla u) = 0 \label{~.C}
\end{EQA}

```

$$\nabla \cdot (\rho \nabla u) = 0 \quad (5.A)$$

$$\nabla \cdot (\rho \nabla u) = 0 \quad (5.B)$$

$$\nabla \cdot (\rho \nabla u) = 0 \quad (5.C)$$

the `\yesnumber` command is necessary to enforce the advancing of equation counter.

8 Use of **fleqn** and **leqno** option

You can use **fleqn** to left justify the equations or **leqno** to number equations on the left. For example:

```

\documentclass{article}
.
.
\usepackage[fleqn,leqno]{easyeqn}
.
.

```

and the following example shows the effect

```

\begin{EQA}[rcll]
  \nabla\cdot(\rho\nabla u)&=&f \quad\quad
  &\mbox{on $\Omega$}\yesnumber \quad\quad
  u&=&u_{0}&\mbox{on $A\subset\partial\Omega$}
  \yesnumber\quad\quad
  (\rho\nabla u)\cdot n&=&u_{1}
  &\mbox{on $B\subset\partial\Omega$}
  \label{eq:5}
\end{EQA}
it is referenced only \eqref{eq:5}!!

```

- (6) $\nabla \cdot (\rho \nabla u) = f \quad \text{on } \Omega$
- (7) $u = u_0 \quad \text{on } A \subset \partial\Omega$
- (8) $(\rho \nabla u) \cdot n = u_1 \quad \text{on } B \subset \partial\Omega$

it is referenced only (8)!!

The same effect can be obtained everywhere using the commands `\equationleft` and `\numberleft` before defining the equation. To restore the default values use the commands `\equationcenter` and `\numberright` after the equation.

9 Cosmetic changes

It is possible to slightly modify the appearance of the equations. There are three parameters that can be changed:

left indent Whenever equations are left justified, the left indent can be changed by the command `\eqleftmargin`.

```
\eqleftmargin{new indent}
```

for example

```
\eqleftmargin{1cm}
```

The default value for the left margin is `\leftmargini`.

equation spacing The spacing of a formula, (default **7pt**) can be controlled by the command

```
\eqspacing{new spacing}
```

for example

```
\eqspacing{4pt}
```

column spacing The spacing among columns (default value **4pt**) can be changed by the command

```
\eqcolumnsep{new spacing}
```

for example

```
\eqcolumnsep{10pt}
```

row spacing The spacing among rows in multiple equations (default value **7pt**) can be changed by the command

```
\eqrowsep{new spacing}
```

for example

```
\eqrowsep{10pt}
```

for example

```

\eqrowsep{20pt}
\eqcolumnsep{10pt}
\eqspacing{1cm}
bla bla bla bla bla bla bla bla bla bla
\begin{EQ}[rcll]
  \nabla\cdot(\rho\nabla u)&=&f \quad \quad
    &\mbox{on } \Omega & \quad \quad \\
  u&=&u_{0}&\mbox{on } A\subset\partial\Omega & \quad \quad \\
  (\rho\nabla u)\cdot n&=&u_{1} &\mbox{on } B\subset\partial\Omega & \\
\end{EQ}
nonsense, nonsense, nonsense, nonsense, nonsense

```

bla bla bla bla bla bla bla bla bla bla

$$\nabla \cdot (\rho \nabla u) = f \quad \text{on } \Omega$$

$$u = u_0 \quad \text{on } A \subset \partial\Omega$$

$$(\rho \nabla u) \cdot n = u_1 \quad \text{on } B \subset \partial\Omega$$

nonsense, nonsense, nonsense, nonsense, nonsense

10 Additional macros

Using the package as follow

```

\documentclass{article}
.
.
\usepackage[...]{easyeqn}
.
.

```

as additional macros useful for typesetting mathematics can be invoked. The macros are defined as `\frac`, `\dfrac`, `\tfrac`, `\binom` and `\boxed` and their use is described in the following example:

$$\frac{\frac{1}{2}}{\frac{1}{2}} = \frac{\frac{1}{2}}{\frac{1}{2}} = \frac{1}{\frac{1}{2}}$$

$$\frac{1}{2} = \frac{1}{2} \binom{n-1}{n-k} \boxed{a+b}$$

```
\[
\eqbox{1+\dfrac{1}{2}} \quad
\eqbox(1pt,20pt){1+\dfrac{1}{2}} \quad
\eqbox(5pt,5pt){1+\dfrac{1}{2}}
\]
```

$$\| \cdot \|_A, \quad \|\cdot\|_A$$

$$||A||, \quad |A|$$

Definition of the macro `\ParDer` and its effect:

```
\[
  \ParDer[xyyz]{f(x,y,z)}, \quad
  \ParDer[{x^2}{x^2}{x^2}y\alpha]{f(x,y,z)}
\]
```

$$\frac{\partial^4 f(x,y,z)}{\partial x \partial y^2 \partial z}, \quad \frac{\partial^5 f(x,y,z)}{\partial x^2 \partial y \partial \alpha}$$

Notice the single item of the derivatives must be a single letter (or a macro) or must be inside a group **{ ... }**. If you use `\ParDer` with package **EASYVECTOR** remember to put macros in brace when use “[]” as follows:

```
\[ \xx, \xx[i,j] =
  \ParDer[\xx\xx{\xx[i,j]}\yy]{f(x,y,z)} \]
```

$$\mathbf{x}, x_{i,j} = \frac{\partial^4 f(x,y,z)}{\partial \mathbf{x}^2 \partial x_{i,j} \partial \mathbf{y}}$$

otherwise you obtain weird results like the following

```
\[ \ParDer[\xx\xx\xx[i,j]\yy]{f(x,y,z)} \]
```

$$\frac{\partial^7 \mathbf{y}}{\partial \mathbf{x}^3 \partial [\partial_i \partial, \partial_j]} f(x,y,z)$$

Definition of the macros `\DIV`, `\GRAD` and `\LAPLA` and their effect:

```
\[ \DIV{A}, \quad \GRAD{B}, \quad \LAPLA{C} \]
```

$$\nabla \cdot A, \quad \nabla B, \quad \Delta C$$

Definition of the macro `\SUM` and its effect:

```
\[
  \SUM{i=1}{100}a_{i},\quad
  \SUM[10]{i=1}{100}a_{i}
\]
```

$$\sum_{i=1}^{100} a_i, \quad \sum_{i=1}^{100} {}^{(10)}a_i$$

Definition of the macro `\PROD` and its effect:

```
\[
  \PROD{i=1}{100}a_{i},\quad
  \PROD[10]{i=1}{100}a_{i}
\]
```

$$\prod_{i=1}^{100} a_i, \quad \prod_{i=1}^{100} {}^{(10)}a_i$$

The environment **ARRAY** is defined, is a simple subset of the environment `array` with a different spacing; look the following example

```
\[
  \left(\begin{array}{cc}
    1 & \frac{1}{2} \\
    \sqrt{3} & \frac{2}{\sqrt{3}}
  \end{array}\right), \quad
  \left(\begin{ARRAY}{cc}
    1 & \frac{1}{2} \\
    \sqrt{3} & \frac{2}{\sqrt{3}}
  \end{ARRAY}\right),
\]
```

$$\left(\begin{array}{cc} 1 & \frac{1}{2} \\ \sqrt{3} & \frac{2}{\sqrt{3}} \end{array} \right), \quad \left(\begin{ARRAY}{cc} 1 & \frac{1}{2} \\ \sqrt{3} & \frac{2}{\sqrt{3}} \end{ARRAY} \right),$$

The environment **MATRIX** is defined, is a simple replacement of `\matrix` command with a different spacing; look the following example

```
\[
  \matrix{
    1          & \frac{1}{2} \cr
    \sqrt{3} & \frac{2}{\sqrt{3}} \cr
  }, \quad
  \begin{MATRIX}
    1          & \frac{1}{2} \cr
    \sqrt{3} & \frac{2}{\sqrt{3}} \cr
  \end{MATRIX},
\]
```

$$\begin{matrix} 1 & \frac{1}{2} \\ \sqrt{3} & \frac{2}{\sqrt{3}} \end{matrix}, \quad \begin{matrix} 1 & \frac{1}{2} \\ \sqrt{3} & \frac{2}{\sqrt{3}} \end{matrix},$$