The counttherefs package

Tobias Hochreiter
tobias.hochreiter@gmx.at

v1.0 from 2023/03/09

1 Bugs

- `align*` environment inside theorem environment in my TSD book (Thm. on f.d. metrics) breaks thm. count AND subsequent equation count

2 Introduction

Sometimes equations (or mathematical theorems/definitions/...) are more important for the subsequent text than others. In order to put emphasize on often-referenced equations (or theorems/...), `counttherefs` counts their `\ref`'s. Look at the following equation (1):

$$a^2 + b^2 = c^2 \tag{1}$$ 0

(1) has a gray number to its right -4- which is (1)'s total number of references, as you can definitely verify yourself (mind the extra `\ref` in subsection 3.3).

3 Usage

We require package `amsmath` for all the display math environments and `amsthm` for theorem-like environments. To turn on the `\ref`-count, just change

`\label` → `\clabel`

in the corresponding (supported) environment. If the package `hyperref` is loaded, load `counttherefs` *afterwards* (i.e. place its `\usepackage` below).

3.1 Supported Environments

- `amsmath` display math environments: `equation`, `align`, `gather`, `split`, ...
- `amsthm` theorem-likes: theorem, definition, lemma, remark, ...

3.2 Not Supported Environments

- `figure`
- `table`

- `itemize` (meaning `\item`'s therein)
- section, subsection, ...

3.3 Options

`left`:	3 (1)	3 **Theorem 1**
`lightgray`:	(1) 3	3 **Theorem 1**
`gray` (default):	(1) 3	3 **Theorem 1**
`darkgray`:	(1) 3	3 **Theorem 1**
`black`:	(1) 3	3 **Theorem 1**
`tiny`:	(1) 3	3 **Theorem 1**
`scriptsize` (default):	(1) 3	3 **Theorem 1**
`footnotesize`:	(1) 3	3 **Theorem 1**
`small`:	(1) 3	3 **Theorem 1**
`normalsize`:	(1) 3	3 **Theorem 1**
`large`:	(1) 3	3 **Theorem 1**
`Large`:	(1) 3	3 **Theorem 1**
`LARGE`:	(1) 3	3 **Theorem 1**
`huge`:	(1) 3	3 **Theorem 1**
`Huge`:	(1) 3	3 **Theorem 1**
`none`:	(1)3	3**Theorem 1**
`space` (default):	(1) 3	3 **Theorem 1**
`*` or `asterisk`:	(1)∗3	3∗**Theorem 1**
`cdot`:	(1)·3	3·**Theorem 1**
`-` or `hyphen` or `textminus`:	(1)-3	3-**Theorem 1**
`minus`:	(1)−3	3−**Theorem 1**
`times`:	(1)×3	3×**Theorem 1**
`underline`:	(1)	**Theorem 1**

0 `ref`'s give 0 underlines, 1 or 2 `ref`'s give 1 underline, 3 or 4 `ref`'s give 2 underlines and 5 or more `ref`'s give 3 underlines.

3.3.1 Indentation

- `totalindent` or `fullindent` (default): The count is `\hspace`'ed fully into the page's margin. E.g. in equation (1).
- `halfindent`: The count is `\hspace`'ed halfly into the page's margin.
- `noindent`: The count is not moved into the page's margin at all.

3.4 Troubleshoot

- DO NOT use `\clabel`'s in non-supported environments.
- If you want to load `hyperref`, load the present package *after* the package `hyperref`. Same for other packages that might re-define `\ref` (this can be a trial-and-error way of shooting the trouble).

`\clabel`
`\thmhead`

4 Implementation

```
\NeedsTeXFormat{LaTeX2e}
\ProvidesPackage{countther efs}[2023/03/09 v1.0 ref Count and Visualization]
\RequirePackage{amsmath}
\RequirePackage{amsthm}
\RequirePackage{totcount}%for the total counters
\RequirePackage{xcolor}%for the text colours
\RequirePackage{etoolbox}%for ifnumcomp command
\RequirePackage{calc}%for option totalindent
\RequirePackage{ulem,xcolor}%for the coloured underline
```

4.1 Options

```
\makeatletter
```

`\CTRcolor@` Colour of bridge and count:

```
\newcommand{\CTRcolor@}{gray}

\DeclareOption{gray}{\renewcommand{\CTRcolor@}{gray}}
\DeclareOption{darkgray}{\renewcommand{\CTRcolor@}{darkgray}}
\DeclareOption{black}{\renewcommand{\CTRcolor@}{black}}
\DeclareOption{lightgray}{\renewcommand{\CTRcolor@}{lightgray}}
```

`\CTRsize@` Size of bridge and count:

```
\newcommand{\CTRsize@}{\scriptsize}

\DeclareOption{Huge}{\renewcommand{\CTRsize@}{\Huge}}
\DeclareOption{huge}{\renewcommand{\CTRsize@}{\huge}}
\DeclareOption{LARGE}{\renewcommand{\CTRsize@}{\LARGE}}
\DeclareOption{Large}{\renewcommand{\CTRsize@}{\Large}}
\DeclareOption{large}{\renewcommand{\CTRsize@}{\large}}
\DeclareOption{normalsize}{\renewcommand{\CTRsize@}{\normalsize}}
\DeclareOption{small}{\renewcommand{\CTRsize@}{\small}}
\DeclareOption{footnotesize}{\renewcommand{\CTRsize@}{\footnotesize}}
```

```
\DeclareOption{scriptsize}{\renewcommand{\CTRsize@}{\scriptsize}}
\DeclareOption{tiny}{\renewcommand{\CTRsize@}{\tiny}}
```

\CTRbridge@ Bridge is the symbol connecting tag w/ count:

```
\newcommand{\CTRbridge@}{\,}

\DeclareOption{none}{\renewcommand{\CTRbridge@}{}}
\DeclareOption{space}{\renewcommand{\CTRbridge@}{\,}}
\DeclareOption{*}{\renewcommand{\CTRbridge@}{*}}
\DeclareOption{asterisk}{\renewcommand{\CTRbridge@}{*}}
\DeclareOption{cdot}{\renewcommand{\CTRbridge@}{\cdot}}
\DeclareOption{-}{\renewcommand{\CTRbridge@}{\text{-}}}
\DeclareOption{hyphem}{\renewcommand{\CTRbridge@}{\text{-}}}
\DeclareOption{textminus}{\renewcommand{\CTRbridge@}{\text{-}}}
\DeclareOption{minus}{\renewcommand{\CTRbridge@}{-}}
\DeclareOption{times}{\renewcommand{\CTRbridge@}{\times}}
```

\CTRindfactor@ The indent factor gives how far the count should be indented into the page's margin:

```
\newcommand*{\CTRindfactor@}{1}

\DeclareOption{noindent}{\renewcommand{\CTRindfactor@}{0}}
\DeclareOption{halfindent}{\renewcommand{\CTRindfactor@}{.5}}
\DeclareOption{totalindent}{\renewcommand{\CTRindfactor@}{1}}
\DeclareOption{fullindent}{\renewcommand{\CTRindfactor@}{1}}
```

4.2 Design of the Count & Underline Option

```
\newlength{\CTRindent@}\setlength{\CTRindent@}{0pt}%
```

\CTRcalcindent@

```
\newcommand{\CTRcalcindent@}[1]{\setlength{\CTRindent@}{\widthof{#1}}}%uses calc package
```

\CTRplaintag@

```
\newcommand{\CTRplaintag@}[1]{(\ignorespaces#1\unskip\@@italiccorr)}%
```

\CTRtagdesign@

```
\newcommand{\CTRtagdesign@}[2]{%#1: \theequation, #2: totcounter
    \def\CTR@{\color{\CTRcolor@}\CTRsize@$\CTRbridge@\total{#2}$}%
    \CTRcalcindent@{\CTR@}%fills CTRindent@
    \CTRplaintag@{#1}{\CTR@}\hspace{-\CTRindfactor@\CTRindent@}%
}
```

\CTRthmnr@

```
\newcommand{\CTRthmnr@}[3]{%
    \def\CTR@{{\color{\CTRcolor@}\CTRsize@$\total{CTRthmtc@\theCTRthmcounter@}\CTRbridge@$}}%
    \CTRcalcindent@{\CTR@}%
    \hspace{-\CTRindfactor@\CTRindent@}\CTR@\thmhead@plain{#1}{#2}{#3}%
}

\DeclareOption{left}{%
    \renewcommand{\CTRtagdesign@}[2]{%
        {\color{\CTRcolor@}\CTRsize@${\total{#2}}\CTRbridge@$}\CTRplaintag@{#1}%
    }%
}
```

\CTRcul@ We now design equation tag and theorem head in the `underline`-option case. Here, the number of underlines (depending on the `totcount`er value) is hardcoded:

```
\newcommand*{\CTRcul@}[2]{\color{\CTRcolor@}\underline{\color{#1}{#2}}\color{black}}%

\DeclareOption{underline}{%
    \renewcommand{\CTRtagdesign@}[2]{%
```

Next line saves the current text color

```
        \colorlet{currcol}{.}%
        \ifnumcomp{\totvalue{#2}}{>}{4}{%
            \CTRcul@{currcol}{\CTRcul@{currcol}{\CTRcul@{currcol}{\CTRplaintag@{#1}}}}%
        }{%
            \ifnumcomp{\totvalue{#2}}{>}{2}{%
                \CTRcul@{currcol}{\CTRcul@{currcol}{\CTRplaintag@{#1}}}%
            }{%
                \ifnumcomp{\totvalue{#2}}{>}{0}{%
                    \CTRcul@{currcol}{\CTRplaintag@{#1}}%
                }{%
                    \CTRplaintag@{#1}%
                }%
            }%
        }%
    }%
    \renewcommand{\CTRthmnr@}[3]{%
        \colorlet{currcol}{.}%
        \ifnumcomp{\totvalue{CTRthmtc@\theCTRthmcounter@}}{>}{4}{%
            \CTRcul@{currcol}{\CTRcul@{currcol}{\CTRcul@{currcol}{\thmhead@plain{#1}{#2}{#3}}}}%
        }{%
            \ifnumcomp{\totvalue{CTRthmtc@\theCTRthmcounter@}}{>}{2}{%
                \CTRcul@{currcol}{\CTRcul@{currcol}{\thmhead@plain{#1}{#2}{#3}}}%
            }{%
                \ifnumcomp{\totvalue{CTRthmtc@\theCTRthmcounter@}}{>}{0}{%
                    \CTRcul@{currcol}{\thmhead@plain{#1}{#2}{#3}}%
                }{%
                    \thmhead@plain{#1}{#2}{#3}%
                }%
            }%
        }%
    }%
}
\ProcessOptions\relax
```

\CTRifcounterex@

4.3 Body of Package

4.3.1 Helpercommands

```
\newcommand*\CTRifcounterex@[1]{%
```

(Because the macro `\c@`⟨*counter*⟩ exists iff ⟨*counter*⟩ exists:)

```
  \ifcsname c@#1\endcsname
    \expandafter\@firstoftwo
  \else
    \expandafter\@secondoftwo
  \fi
```

```
}
```

\CTRsteporcreate@

```
\newcommand*\CTRsteporcreate@[1]{%
    \CTRifcounterex@{#1}{%
        \stepcounter{#1}%
        }{%
        \newtotcounter{#1}%
        \stepcounter{#1}%
        }%
}
```

4.3.2 Redefining the ref command

We now redefine `\ref` to step the resp. totcounter. Unfortunately, this command has reputation to get re-defined by lots of packages. Not every re-definition will destroy expected behaviour though. However, it is known that `hyperref` must be loaded before `counttherefs`. Also, for more robustness and hyperref compatibility the following re-definition of `\ref` is quite long. It's inspired by https://tex.stackexchange.com/a/68040:

```
\AtBeginDocument{%
  \newcommand*{\original@ref}{}%
  \let\original@ref\ref
  \@ifpackageloaded{hyperref}{%
    \renewcommand*{\ref}{%
      \@ifstar\newrefstar\newref
    }%
    \newcommand*{\newrefstar}[1]{%
      \original@ref*{#1}%
      \CTRsteporcreate@{#1@rc}%
    }%
    \newcommand*{\newref}[1]{%
      \hyperref[#1]{\newrefstar{#1}}%
    }%
  }{%
    \renewcommand*{\ref}[1]{%
      \original@ref{#1}%
      \CTRsteporcreate@{#1@rc}%
    }%
  }%
}
```

\CTRenvfig@

4.3.3 Code's Core: clabel

```
\def\CTRenvfig@{figure}
```

\CTRenvtab@

```
\def\CTRenvtab@{table}
```

\clabel

```
\newcommand{\clabel}[1]{%
```

First, call the plain old label:

```
    \label{#1}%
```

Then, check if the current inner-most environment is one that does NOT support `\clabel`:

```
    \ifx\CTRenvfig@\@currenvir\else%
    \ifx\CTRenvtab@\@currenvir\else%
```

(Currently no check if the `\clabel` belongs to an `\item` or a section is made.) Now, a `newtotcounter` to determine if this `\clabel` is used for an equation:

```
    \CTRifcounterex@{CTRfortagform@#1}{}{\newtotcounter{CTRfortagform@#1}}%
```

Here, we create the actual `totcounter` of the `\ref`'s that reference the current `\clabel`:

```
    \CTRifcounterex@{#1@rc}{}{\newtotcounter{#1@rc}}%
```

If the *final* anwer to: "Is this `\clabel` meant for an equation?" is *No*, then we conclude that it's for a theorem, set the respective switch and fill the counter:

```
    \ifCTRinthm@\ifnumcomp{\totvalue{CTRfortagform@#1}}{=}{0}{%if curr. clabel not eq
        \setcounter{CTRthmtc@\theCTRthmcounter@}{\totvalue{#1@rc}}%
        \setcounter{CTRthmclabeled@\theCTRthmcounter@}{1}%
    }{}\fi%
```

Now comes the place where we re-design the equation tag. This part is tricky: We re-design, even if this `\clabel` wasn't even meant for an equation. This is not a problem. Because the new design would not get called in this scenario - but overwritten by the next `\clabel` that actually *is* meant for an equation. To round up the edges, this strategy forces us to re-define `\@endtheorem` which is explained at the corresponding line.

```
    \gdef\tagform@##1{%gdef because align-likes are nested
        \maketag@@@{\CTRtagdesign@{##1}{#1@rc}}%we use our new tag
        \stepcounter{CTRfortagform@#1}%
        \gdef\tagform@####1{\maketag@@@{\CTRplaintag@{####1}}}%back to standard design
    }
```

The last gdef will apply precisely at first call of `\tagform@` so the counter is added precisely once - as desired.

```
    \fi\fi%the else for the @currenvir
}
```

Redunant `\newif` for robustness:

```
\newif\ifCTRinthm@
```

Internal counter as workaround because `\thmhead` is called before `\clabel` even appears:

```
\newcounter{CTRthmcounter@}
```

`\thmhead` `\thmhead` is called by every `amsthm` theorem-like env so this is our entry point to manipulate the design of the theorem head by adding the `\ref`-count:

```
\renewcommand{\thmhead}[3]{
    \global\CTRinthm@true%
    \stepcounter{CTRthmcounter@}%
```

Now, `\newtotcounter{CTRthmtc@\theCTRthmcounter@}` DOES NOT WORK. Problem: totcount and loops defining newtotcounters with macros as name gives *some* error. Workaround (and better explanation https://tex.stackexchange.com/a/245125)

```
    \begingroup\edef\x{\endgroup
        \noexpand\global\noexpand\newtotcounter{CTRthmtc@\theCTRthmcounter@}%
    }\x%
    \begingroup\edef\x{\endgroup
        \noexpand\global\noexpand\newtotcounter{CTRthmclabeled@\theCTRthmcounter@}%
    }\x%
```

the above worked on the 14.03.2023 - this is probably very susceptible to `totcount` changes! So if some future error occurs, the above is a great place to double check. We finally call (or not call) our chosen design of the theorem head, depending on whether there was a `CTRthmclabeled@` counter that was set to 1 by a `\clabel` in the current theorem(-like) environment:

```
    \ifnumcomp{\totvalue{CTRthmclabeled@\theCTRthmcounter@}}{=}{1}{%
        \CTRthmnr@{#1}{#2}{#3}%
    }{%
        \thmhead@plain{#1}{#2}{#3}%macro provided by amsthm
    }%
}
```

`\@endtheorem` The last step is to reset our switch and equation design. The latter being necessary for (e.g.) the case that a `\clabled`'ed theorem is followed by a mere `\label`'ed equation.
Rest of the following is copied from the `amsthm` code.

```
\renewcommand{\@endtheorem}{%
    \global\CTRinthm@false%
    \gdef\tagform@##1{\maketag@@@{\CTRplaintag@{##1}}}%
    \endtrivlist\@endpefalse%
}%end theoremhead
\makeatother
\endinput
```

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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.