Wick contractions in \LaTeX with simplewick.sty

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This is a manual accompanying the style file simplewick.sty providing macros \acontraction and \bcontraction to draw Wick contractions above and below expressions, respectively. The functionality is best illustrated by an example,

\[
\begin{array}{c}
\contraction{}{A}{B}{C}
\contraction[2ex]{A}{B}{C}{D}
ABCD
\end{array}
\]

\[
\begin{array}{c}
a_i(t_1)a_j(t_1)a_i(t_1)a_i(t_1)a_j(t_2)a_j(t_2)\end{array}
\]

1 Usage

The syntax will be explained on something simpler, however. The sequence

\[
\begin{array}{c}
\contraction{}{A}{B}{C}
\contraction[2ex]{A}{B}{C}{D}
ABCD
\end{array}
\]

renders as

\[
\begin{array}{c}
ABCD
\end{array}
\]

The parameters of the macro \acontraction\{\{\{\}{}\}{}\} (which is a synonym for \acontraction[]{}\{}\}{}\} are as follows.

- The first (optional) argument is the height of the contraction. When omitted (as in the first contraction above) it defaults to 1ex,
- the second argument contains the expression that lies before the contraction start,
- the third argument contains the expression, above which the start of the contraction is centered,
- the fourth argument is the part of the formula that is bridged by the contraction, and finally
- the contraction ends above the center of the last argument of the macro.
Note that the macro itself typesets only the contraction alone and rewinds back to allow for multiple contractions. Therefore, the expression to appear below the contraction(s) has to be repeated once more when you are finished with contractions themselves.

I guess now it is the right time to move to that “real life” example from the beginning of this manual. Its source is

$$
\begin{align*}
\text{2 Constructions inside the text — stretching and shrinking} \\
\text{The macro } \texttt{\textbackslash contraction} \text{ is prone to giving not entirely satisfactory results when the formula is under stress or tension, i.e., when TeX shrinks or stretches “the glue” from its natural width. When we try to squeeze the line } \\
\text{Contraction under stress} \\
\text{\texttt{\textbackslash contraction}\{\mathbf{G}\}\{}_{1}(\mathbf{q}_{1})\mathbf{G}_{2}(\mathbf{q}_{2}) = \chi_{12}(\mathbf{q}_{1}-\mathbf{q}_{2}) \\
\text{and with no stress} \\
\text{\texttt{\textbackslash contraction}\{\mathbf{G}\}\{}_{1}(\mathbf{q}_{1})\mathbf{G}_{2}(\mathbf{q}_{2}) = \chi_{12}(\mathbf{q}_{1}-\mathbf{q}_{2}) \\
\end{align*}
$$
This is not quite right since the contraction drawn on the first line is slightly too long, although its length is precisely the same as the length of the contraction on the second line — they were entered via the same piece of code, after all. The style `simplewick.sty` offers a fix for this inconsistency in the form of the macro \texttt{\nomathglue{}} that prevents TeX to shrink or stretch its argument. When used

\begin{verbatim}
\contraction{}{}{}
\bar G_1(\mathbf{q}_1) \bar G_2(\mathbf{q}_2) = \bar \chi_{12}(\mathbf{q}_1 - \mathbf{q}_2).
\end{verbatim}

the outcome should look precisely as we wanted.

### 3 Alternatives

An alternative method for typesetting Wick contractions with \LaTeX is a \texttt{wick.sty} by Taichiro Kugo, available at

\url{http://www2.yukawa.kyoto-u.ac.jp/~kugo/index-e.html}

It is actually a more advanced solution than the one presented here (which is the reason why I call this package `simplewick`). Unfortunately, \texttt{wick.sty} seems to be somewhat conflicting with \texttt{amsmath} package. For example, I did not succeed to draw the \texttt{wick.sty} contractions above accented characters (such as those in the stretching examples above) when \texttt{amsmath} was loaded. Without \texttt{amsmath} it was just fine, however.
4 Credits

The package simplewick.sty is based on the code from thophys.sty by Thorsten Ohl that dates back to 1994. I only added the contractions below expressions (\bcontraction), the stretching/shrinking fix \nomathglue and this documentation. Contact information can be obtained by issuing a command \simplewickcontact.

5 The Code

1 \def\fileversion{v1.2a}
2 \def\filedate{2007/11/23}
3 \ProvidesPackage{simplewick}[\filedate\space\fileversion]
4 \typeout{Package: simplewick \fileversion\space (\filedate)}
5 \makeatletter
6 % ----
7 % contraction above the expression
8 % ----
9 \newbox\swb@xone
10 \newbox\swb@xtwo
11 \newbox\swb@xthree
12 \newbox\swb@xfour
13 \newdimen\swdimen@ne
14 \newdimen\swdimentw@
15 \makeatletter
16 % ----
17 % contraction above the expression
18 % ----
19 \newcommand{\acontraction}[5][1ex]{%
20  \mathchoice
21  {\acontraction@\displaystyle{#2}{#3}{#4}{#5}{#1}}%
22  {\acontraction@\textstyle{#2}{#3}{#4}{#5}{#1}}%
23  {\acontraction@\scriptstyle{#2}{#3}{#4}{#5}{#1}}%
24  {\acontraction@\scriptscriptstyle{#2}{#3}{#4}{#5}{#1}}%
25 \acontraction@[6]{%
26  \mbox{\acontraction@\displaystyle{#2}{#3}{#4}{#5}{#1}}%
27  \mbox{\acontraction@\textstyle{#2}{#3}{#4}{#5}{#1}}%
28  \mbox{\acontraction@\scriptstyle{#2}{#3}{#4}{#5}{#1}}%
29  \mbox{\acontraction@\scriptscriptstyle{#2}{#3}{#4}{#5}{#1}}%
30 \acontraction@[6]{%
31  \mbox{\acontraction@\displaystyle{#2}{#3}{#4}{#5}{#1}}%
32  \mbox{\acontraction@\textstyle{#2}{#3}{#4}{#5}{#1}}%
33  \mbox{\acontraction@\scriptstyle{#2}{#3}{#4}{#5}{#1}}%
34  \mbox{\acontraction@\scriptscriptstyle{#2}{#3}{#4}{#5}{#1}}%
35 \swdimen@ne=\wd\swb@xtwo%
36 \advance\swdimen@ne by \wd\swb@xfour%
37 \divide\swdimen@ne by 2%
38 \vbox{%
\hbox to \Opt{%
  \kern \wd\swb@xone%
  \kern 0.5\wd\swb@xtwo%
  \acontraction@@\{\swdimen\one\}{#6}%
  \hss}%
\vskip 0.5ex% how far above the line starts
\vskip\ht\swb@xtwo}}
\newcommand{\acontracted}[5][1\text{ex}]{%
  \acontraction[1]{#2}{#3}{#4}{#5}\ensuremath{#2#3#4#5}}
\newcommand{\acontraction}@ [3][0.05\text{em}]{%
  \% the 1st parameter (explicitly inserted) is the width
  \% of the contraction line
  \hbox{%
    \vrule width #1 height \Opt depth \Opt%
    \vrule width #2 height \Opt depth \text{\Opt}%
    \vrule width \Opt height \Opt depth \Opt%
    \relax}}
\newcommand{\bcontraction}@ [5][\text{\Opt}]{%
  \mathchoice
  {
    \bcontraction@[\text{displaystyle}]{\swdimen\one\}{#6}{}{}}\%}
  {
    \bcontraction@[\text{textstyle}]{\swdimen\one\}{#6}{}{}}\%}
  {
    \bcontraction@[\text{scriptstyle}]{\swdimen\one\}{#6}{}{}}\%}
  {
    \bcontraction@[\text{scriptscriptstyle}]{\swdimen\one\}{#6}{}{}}\%}
\newcommand{\bcontracted}[5][\text{\Opt}]{%
  \bcontraction@[\swdimen\one\]{#6}{}{}}
\newcommand{\bcontraction}@ [3][0.05\text{em}]{%
  \% the 1st parameter (explicitly inserted) is the width
  \% compatibility with the previous version
  \let\contraction\acontraction
  \% ----
  \% contraction below the expression
  \% ----
  \newcommand{\bcontraction}@ [5][1\text{ex}]{%
    \mathchoice
    {\bcontraction@[\text{displaystyle}]{\swdimen\one\}{#6}{}{}}\%}
    {\bcontraction@[\text{textstyle}]{\swdimen\one\}{#6}{}{}}\%}
    {\bcontraction@[\text{scriptstyle}]{\swdimen\one\}{#6}{}{}}\%}
    {\bcontraction@[\text{scriptscriptstyle}]{\swdimen\one\}{#6}{}{}}\%}
\newcommand{\bcontracted}@ [5][1\text{ex}]{%
88 % of the contraction line
89 \hbox{%
90 \swdimentw@=#3
91 \advance\swdimentw@ by -#1
92 \vrule width #1 height 0pt depth #3%
93 \lower\swdimentw@\hbox{\vrule width #2 height 0pt depth #1}%
94 \vrule width #1 height 0pt depth #3%
95 \relax}}
96
97 \makeatother
98
99 % ----
100 % macro to switch off shrinking/stretching in mathmode
101 % (consult TeXbook, page 168, to see where the numbers came from)
102 % ----
103 \newcommand\nomathglue[1]{
104 \begingroup
105 \thinmuskip=3mu \medmuskip=4mu \thickmuskip=5mu
106 #1
107 \endgroup
108 }
109
110 % ----
111 % obfuscated contact info
112 % ----
113 \newcommand\simplewickcontact{%
114 {\tt \{x\}\{o\}\{l\}\{o\}\{r\}\{e\}\{n\}\{c\}\{\tt \theta\}\{f\}\{z\}\{u\}\{.\}\{c\}\{z\}}%
115 }
116
117 ⟨/simplewick.sty⟩