The MATHDOTS package*

Dan Luecking

2014/06/11

Abstract

This package provides vertical dots and diagonal dots in math, slanting in either direction. It should work equally well in \LaTeX or plain \TeX. It improves on the default definitions of plain \TeX and \LaTeX. Similar improvements are provided for the triple and quadruple dot accents of AMSTeX/AMSLaTeX.

1 Introduction

Running \LaTeX or \TeX on mathdots.ins generates mathdots.sty, a \LaTeX package, and mathdots.tex a plain \TeX input file. If one puts \input mathdots.sty in a plain \TeX file, it will cause mathdots.tex to be input. This is for backward compatibility.

Unlike the commands \ddots and \vdots provided by \LaTeX, the versions defined by MATHDOTS change size with \LaTeX size changing commands, as well as in \{sub\super\}scripts. After MATHDOTS is loaded, \{\texttt{\large$\ddots$}\} will be larger and \{\texttt{\small$\ddots$}\} will be smaller than $\ddots$ at normal size. Moreover, $2^2^{2^{2^{\ddots}}} \equiv 2^{2^{2^{2^{\ddots}}}}$ will also produce a smaller symbol. This last example is very unlikely to be needed, but the version with the opposite slant is very common (and is provided by MATHDOTS).

The AMSMATH accents \dddot and \dddddot have similar problems that MATHDOTS attempts to correct when AMSMATH is loaded.

See Table 1 for examples of the MATHDOTS commands at different sizes and in exponents. See Table 2 for comparison, showing the results without MATHDOTS.

\ddots

\ddots

The default \LaTeX (and plain \TeX) definition changes the size of the dots, and the horizontal dimensions, but not the vertical dimensions, giving them different slants at different sizes. Also, using the default version in ‘scripts produces symbols identical to those produced elsewhere. Finally, the default takes the dots from the current text font, whereas the MATHDOTS package takes them from the current math symbol font, so they should match other dots in math mode. This is only really a concern in 17pt sizes or larger where \texttt{cmr17} is scaled to get text dots, but \texttt{cmm12} is scaled to get math dots.

\iddots

MATHDOTS supplies also \iddots, with behavior similar to \ddots, except it produces the other diagonal. This command is not provided in basic \TeX or \LaTeX.

\vdots

\vdots produces vertical dots (as in standard \TeX or \LaTeX), but again, the

\*This file has version number v0.9, last revised 2014/06/11.
With \texttt{mathdots}:

<table>
<thead>
<tr>
<th>Command</th>
<th>Large</th>
<th>normal</th>
<th>scriptsize</th>
<th>in exponents</th>
</tr>
</thead>
<tbody>
<tr>
<td>\ddots</td>
<td>\ddots</td>
<td>\ddots</td>
<td>\ddots</td>
<td>2^{\ddots} 2^{2^{\ddots}}</td>
</tr>
<tr>
<td>\vdots</td>
<td>\vdots</td>
<td>\vdots</td>
<td>\vdots</td>
<td>2^{\vdots} 2^{\vdots}</td>
</tr>
<tr>
<td>\iddots</td>
<td>\iddots</td>
<td>\iddots</td>
<td>\iddots</td>
<td>2^{\iddots} 2^{\iddots}</td>
</tr>
<tr>
<td>\dddot{X}</td>
<td>\dddot{X}</td>
<td>\dddot{X}</td>
<td>\dddot{X}</td>
<td>2^{\dddot{X}} 2^{2^{\dddot{X}}}</td>
</tr>
<tr>
<td>\ddddot{X}</td>
<td>\ddddot{X}</td>
<td>\ddddot{X}</td>
<td>\ddddot{X}</td>
<td>2^{\ddddot{X}} 2^{2^{\ddddot{X}}}</td>
</tr>
</tbody>
</table>

Table 1: Dots at different sizes and in exponents.

Without \texttt{mathdots}:

<table>
<thead>
<tr>
<th>Command</th>
<th>Large</th>
<th>normal</th>
<th>scriptsize</th>
<th>in exponents</th>
</tr>
</thead>
<tbody>
<tr>
<td>\ddots</td>
<td>\ddots</td>
<td>\ddots</td>
<td>\ddots</td>
<td>2^{\ddots} 2^{2^{\ddots}}</td>
</tr>
<tr>
<td>\vdots</td>
<td>\vdots</td>
<td>\vdots</td>
<td>\vdots</td>
<td>2^{\vdots} 2^{\vdots}</td>
</tr>
<tr>
<td>\dddot{X}</td>
<td>\dddot{X}</td>
<td>\dddot{X}</td>
<td>\dddot{X}</td>
<td>2^{\dddot{X}} 2^{2^{\dddot{X}}}</td>
</tr>
<tr>
<td>\ddddot{X}</td>
<td>\ddddot{X}</td>
<td>\ddddot{X}</td>
<td>\ddddot{X}</td>
<td>2^{\ddddot{X}} 2^{2^{\ddddot{X}}}</td>
</tr>
</tbody>
</table>

Table 2: Dots without \texttt{mathdots}. 

2
MATHDOTS version will change size with size changing commands. The old behavior is stored in \texttt{\textbackslash fixedddots} and \texttt{\textbackslash fixedvdots}. If you wish \texttt{\textbackslash fixedddots} \texttt{\textbackslash fixedvdots} \texttt{\textbackslash fixediddots} \texttt{\textbackslash iddots} to behave similarly then use \texttt{\textbackslash fixediddots}. On the chance that some other package changes the behavior before MATHDOTS is loaded, use \texttt{\textbackslash originalddots}, \texttt{\textbackslash originalvdots}, and \texttt{\textbackslash originaliddots} to obtain the versions in force before MATHDOTS is loaded.

If the AMSMATH package is detected in \LaTeX{}, the commands \texttt{\textbackslash ddot} and \texttt{\textbackslash dddot} are modified to get the same size changing behavior in 'scripts. They also correct a positioning bug in the AMSMATH code. Compare the old and new versions and the 2-dot accent (from basic \LaTeX{}): $\dddot{X}$, $\dddot{X}$, $\dddot{X}$. I have also taken the liberty of changing the spacing between dots to match that in the 2-dot accent.

Some of the changes to \texttt{\textbackslash ddot} and \texttt{\textbackslash dddot} require the command \texttt{\textbackslash text}, and so is only applied if AMSMATH has been loaded \textit{before} MATHDOTS. The old amsmath commands are saved in \texttt{\textbackslash originaldddot} and \texttt{\textbackslash originalddddot}. Similar comments apply to plain \TeX{} with regard to \texttt{amstex.tex}.

Different math fonts have different metrics for the \dot and \ddot accents. If you use a math font family other than the CM fonts, you can adjust the positioning and spacing of the the dots in \texttt{\textbackslash ddot} and \texttt{\textbackslash dddot} to better match the spacing in \texttt{\textbackslash ddot} with the following length commands: \texttt{\MDoprekern}, \texttt{\MDodotkern} and \texttt{\MDopostkern}. These adjust the space before the first dot, between the dots and after the last dot, respectively. They are in units of \texttt{mu}, which is $1/3$ the size of the space made by \texttt{,}. Reducing the first and/or increasing the last one cause the dots to be shifted left. Reducing the middle one causes the dots to be closer together. As there is usually a bit of white on either side of the dot character, these usually have to be given negative values (so “reduce” means “make more negative”). The defaults for the CM fonts are accomplished by the commands

\begin{verbatim}
\MDoprekern=0mu
\MDodotkern=-1.3mu
\MDopostkern=-1mu
\end{verbatim}

I have found that the MATHPTMX package (Times fonts in text and math) benefits from changing these via the following commands

\begin{verbatim}
\MDoprekern=-1mu
\MDodotkern=-2mu
\MDopostkern=0mu
\end{verbatim}

\texttt{\MDoprekern}, \texttt{\MDodotkern}, and \texttt{\MDopostkern} were made user-accessible commands in version 0.9.

In \LaTeX{}, all these commands have been made robust as of version 0.6. On the chance that some later loaded package changes things, the MATHDOTS versions can be obtained with \texttt{\textbackslash Doddots}, \texttt{\textbackslash Dovdots}, \texttt{\textbackslash Doiddots}, \texttt{\textbackslash Doddddots} and \texttt{\textbackslash Diddots} (as of version 0.9).
2 The implementation

The following are commands for plain TeX that prevent double loading, announce the package name, and change/restore the category of @.

\begin{verbatim}
\langle*\texttt{tex} \rangle
\expandafter
\ifx\csname MathDots\mathdotsfileversion\endcsname\relax
\else
 \immediate\write16{Mathdots already loaded.}\expandafter\endinput
\fi
\immediate\write16{Package mathdots, \mathdotsfiledate space version \mathdotsfileversion.}%
\expandafter\edef\csname MathDots\mathdotsfileversion\endcsname{\catcode'\noexpand@=\the\catcode'@}%
\catcode'@=11
\def\@nameuse#1{\csname#1\endcsname}%
\langle/\texttt{tex}\rangle
\end{verbatim}

Now various shorthands. For example \texttt{\textstyle\textbackslash MDo@us\textbackslash MDo@t} becomes \texttt{\textstyle\textbackslash\texttt{text}}, and \texttt{\textstyle\textbackslash MDo@uf\textbackslash MDo@ss} produces \texttt{\textstyle\textbackslash\texttt{scriptscript}}.

\def\MDo@us#1{\@nameuse{#1style}}%
\def\MDo@uf#1{\@nameuse{#1font}0}%
\def\MDo@t{text}\def\MDo@s{script}\def\MDo@ss{scriptscript}%
\newdimen\MDo@unit \MDo@unit\p@

The following are the main utility macros to implement changes of style. Since most of our symbols are built with boxes, they have to exit math mode and need \texttt{\textbackslash mathchoice} so we know the current style (i.e., size) when we re-enter math mode.

We detect differences in sizes (for example, after \texttt{\textbackslash large}) by examining the appropriate \texttt{\fontdimen} of family 0. Instead of the hard coded 1pt, we use 0.1em from this family.

We pass along the current style via \texttt{\textbackslash everymath}.

In \texttt{\textbackslash MDo@palette\#1} is a command which we feed the current style name. For example, \texttt{\textbackslash MDo@palette\textbackslash MDo@ddots} will be our definition of \texttt{\textbackslash ddot}s. Then \texttt{\textbackslash MDo@ddots} will see the current style as its first argument.

\def\MDo@ddots#1{{\MDo@changestyle{#1}%%
\mkern1mu\raise7\MDo@unit\vbox{\kern7\MDo@unit\hbox{\MDo@dot}}%%
\mkern2mu\raise4\MDo@unit\hbox{\MDo@dot}%%
\mkern2mu\raise\MDo@unit\hbox{\MDo@dot}\mkern1mu}}%
\def\MDo@vdots#1{\vbox{\MDo@changestyle{#1}%%
\everymath{\expandafter{\the\everymath\MDo@us{#1}}}%}
\def\MDo@unit\unhbox1\box0}}%

In the following commands, \#1 is the current style (supplied via \texttt{\textbackslash MDo@palette}). Except for the change in the unit used and the dot used, the first two definitions are essentially the same as plain's \texttt{\textbackslash ddot}s and \texttt{\textbackslash vdot}s, and the third is the same as the first with the boxes reversed.

\def\MDo@ddots#1{{\MDo@changestyle{#1}%%%%%%%%
\mkern1mu\raise7\MDo@unit\vbox{\kern7\MDo@unit\hbox{\MDo@dot}}%}
\def\MDo@vdots#1{\vbox{\MDo@changestyle{#1}%%%%%%%%
\everymath{\expandafter{\the\everymath\MDo@us{#1}}}%}
We include current (as of 2014/06/11) \LaTeX/plainTex definitions so a user can choose them. \LaTeX and plain\TeX don't have the other diagonal, so we provide a \texttt{\fixediddots} which is just \texttt{\fixedddots} with the boxes reversed.

We save the versions at load time so user can use them in case he loads \texttt{\mathdots} for its other features. Chances are the original \texttt{\iddots} is undefined. Here are the actual (re)definitions of these three commands. The plain\TeX version emits messages similar to that produced by \LaTeX's \texttt{\DeclareRobustCommand}.

Since \texttt{\ddots} et al. are defined in \LaTeX with \texttt{\DeclareRobustCommand}, saving the original definition with \texttt{\let\originaliddots=\iddots} will not work unless the internal command "\texttt{\iddots}" is unchanged. Thus we can't use \texttt{\DeclareRobustCommand\iddots} directly because it changes that internal. Instead we define \texttt{\MDoddots} and then do \texttt{\let\iddots=\MDoddots}.
Now we try to get AMS \dddot and \ddddot accents to behave nicely.

We add a \kern\z@ to prevent TeX from vertically centering #1. I don’t know if the \text command is necessary, but it doesn’t seem to hurt. I included it in the original version because that one used text dots and needed the text to change size. Now I use a math symbol (the dot accent) and \mathpalette to implement the change. Still, I don’t really understand how \ex@ works in the AMS packages, so I leave it in. For possible fine tuning, I have used two macros that represent the math spacing placed before and after the sequence of dots (\MDoprekern and \MDopostkern). Also, the actual dot is in the definition of \MDodotkern where another spacing command follows the dot (\MDodotkern). In fact, by changing \MDodotkern and changing the spacing, one can define other multiple “dot” accent commands.

We also save the original AMSTEX versions.

% For plain tex + amstex: \ex@ is set in amstex.tex to .2326ex, so its value depends on the value of ex when AMSTEX is loaded. Unlike AMSTEX, it doesn’t seem to be recalculated with size changes. Thus, in plain TeX we add a reset.

%
\Index

Numbers refer to the page(s) where the corresponding entry is described.

\begin{tabular}{lll}
D & I & O \\
\dddot & 3, 6 & \iddots & 1, 5 & \MDoovdots & 3 \\
\ddots & 3, 6 & & & & \\
\ddots & 1, 5 & & & & \\
\fixedddots & 3, 5 & & & & \\
\fixediddots & 3, 5 & & & & \\
\fixedvdots & 3, 5 & & & & \\

M & & \\
\MDoovdots & 3 \\
\originaldddot & 3, 6 \\
\originaliddots & 3, 6 \\
\originalvdots & 3, 5 \\

V & & \\
\MDoovdots & 3 \\
\originaldddot & 3, 6 \\
\originaliddots & 3, 6 \\
\originalvdots & 3, 5 \\
\end{tabular}