# Avant Garde Mathematical Typesetting

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## Introduction

This is a survey of current developments in mathematical typesetting, primarily in relation to TEX, although I will also touch briefly on some non-TEX alternatives.

There are at least three interesting avenues of TEX development that build on the Web code base: pdfTEX, Omega, and e-TEX. For the most part these "children of TEX" do not provide any enhancements in the area of mathematical typesetting. One exception, however, is ε-TEX's `\middle` command, added to go with `\left` and `\right`.

And Matthias Clasen has put together some change files for ε-TEX that are quite interesting, particularly the support for under-accents and the provision of a "current math style" variable.

Recently (March 1999) MathML translation capabilities were added to Omega. The translator TEX4ht also has MathML capabilities now.

## Taco Hoekwater's Type 1 math fonts

An important service has been rendered to the TEX community by Taco Hoekwater in converting various math fonts to Type 1 format and making them available for general use.

ftp://ctan.tug.org/tex-archive/fonts/rsfs/ps-type1/hoekwater/
ftp://ctan.tug.org/tex-archive/fonts/stmary/ps-type1/hoekwater/
ftp://ctan.tug.org/tex-archive/fonts/wasy2/ps-type1/hoekwater/

He has also produced some math symbol fonts that are designed to be visually compatible with Times fonts:

http://www.cybercomm.nl/~bittext/fonts
http://www.cybercomm.nl/~bittext/fonts/fonts.zip

## Other math fonts

The `yhcmex10` font created by Yannis Haralambous provides additional extension characters. The Metafont source code for this font can be found in the `.dtx` file, which also contains macros for using the fonts.

ftp://ctan.tug.org/tex-archive/macros/latex/contrib/supported/yhmath/yhmath.dtx

## TeX Extended Mathematics Font Encoding (TUG WG 92-0

The goal of TUG working group 92-01 is to produce a new encoding scheme for mathematical fonts to use 256 symbols per font instead of 128. Matthias Clasen and Ulrik Vieth have been the principal architects of such a scheme. The TUG page listed below has links to many other math font resources. The Freiburg site has a summary by Clasen of what files can be downloaded to try the new encodings.

http://tug.org/twg/mfg/
ftp://peano.mathematik.uni-freiburg.de/pub/mathfont/

## Matthias Clasen's change files for mathstyle, underaccent, e

The change files in this location provide various significant enhancements of TEX's mathematical capabilities:

ftp://peano.mathematik.uni-freiburg.de/pub/etex/math/
ftp://peano.mathematik.uni-freiburg.de/pub/etex/README

To download, you will probably want to get these changefiles as part of:

ftp://peano.mathematik.uni-freiburg.de/pub/etex.tar.gz

In particular, providing a current math style variable has far-reaching implications for math font handling and for dealing with certain other complications associated with `\mathchoice` in standard TEX.

### The `flexisym` package

The `flexisym` package, which was developed for the use of the `breqn` package, makes it possible to redefine all math symbol commands (including, say, `[` and `x`) to run arbitrary macros instead of a simple mathchar reference. Although this is particularly useful in applications like the `breqn` package, it is possible to imagine other uses:

- doing something clever to prevent a line break after the plus sign in an in-line formula like $f(x+y)$
- implementing the `\boldsymbol` idea in a way yet more robust than either the `amsbsy` or the `bm` package by a suitably clever arrangement of indirect mathgroup references
- packing multiple math alphabets into a single 256-character font and arranging for something like `\mathbb{R}` to select the necessary offset from the standard R position

### The Bezos `accents` package

The `accents` package by Javier Bezos, which may be found at

ctan.tug.org/tex-archive/macros/latex/contrib/supported/bezos/

provides macros for doing under-accents, compound accents, and accents using arbitrary symbols other than the accent symbols. The compound accent facilities provided by the `amsmath` package are in comparison relatively limited.

### Display math markup (breqn)

An alpha version of a package called `breqn` was released by the American Mathematical Society in October 1997. One of its main goals is to provide automatic line-breaking for displayed equations, even to the point of allowing breaks between `\left`-`\right` delimiter pairs. But it also includes some innovations in the markup of displayed equations, such as allowing natural placement of ending punction:

```
\begin{equation}
...
\end{equation},
```

and requiring each equation to be written with a separate environment rather than having multiple equations lumped together in a single `\begin{eqnarray}` with only a `\\` to separate them and no way to tell whether a given `\\` is a break between equations or a break within an equation.

In the current development version of the `breqn` package, a sequence such as

```
\end{equation}
\end{proof}
```

will lead to the Q.E.D. symbol being pulled inside the equation automatically instead of having to be specified by hand.

The `breqn` package uses a lot of dimen registers, and rather than taking the XY-Pic approach of minimizing the number of dimen registers allocated by extensive use of slow workaround methods, I am inclined to think that switching to $\varepsilon$-TEX or Omega may be the best way to solve that problem for users who want to use the `breqn` package in conjunction with other dimen-hog packages. (A vanilla / document that only uses a generic documentclass and the `breqn` package will still run OK with TEX 3.x.)

A nice typographic enhancement gained as a side effect of the `breqn` work is better placement of sub and superscripts on large parentheses, as described in the following section.

### Kerning of superscripts on large parens

Observant users of TEX will have noticed that in constructions like

$$\Psi\left(\frac{n+1}{n},\frac{n-1}{n}\right)^2$$

the superscript on the large closing delimiter falls too far away from it. As the parentheses grow larger the effect becomes more noticeable. `\rangle` and `\rbrace` delimiters also suffer from this effect. In the (as-yet-unreleased) beta version of the `breqn` package, the space is closed up automatically. This would have been rather difficult to do from scratch, but the special handling of delimiter symbols that was needed for the main purposes of the `breqn` package provided most of the necessary infrastructure, so that adding this feature as a refinement was relatively easy.

### Non-TEX alternatives

**MathML possibilities** MathML is a language of recent origins for writing mathematical formulas in XML notation. One of the motives behind the design of MathML was to make it possible to present mathematical formulas on the World-Wide Web without converting them to GIFs (latex2html) or drastically reducing their typeset quality (tth). The current choices for viewing WWW documents that contain MathML seem to be:

**Amaya** Testbed browser for the W3C. Latest release: January 1999.

http://www.w3.org/pub/WWW/Amaya/

*Limitations*: Apparently only available for certain Unix platforms.

**TechExplorer** Originally this was a browser plug-in for viewing TEX documents on the WWW directly. Now it has MathML capabilities as well.

http://www.software.ibm.com/enetwork/techexplorer/

*Limitations*: Runs only as a plug-in for Netscape Navigator or Internet Explorer, and only on Windows or Linux platforms. Rendering speed is very good however, the best among all applications in this category, and on-screen quality is fairly good.

**WebEQ** This is a Java applet that can be used for rendering math formulas when they are embedded as applet calls in an HTML document.

http://www.webeq.com/webeq/

*Limitations*: On some systems, at least, running a Java applet for dozens of math formulas in a math-intensive HTML page may be as slow as downloading dozens of GIFs. Furthermore, the applets run again every time you re-enter a page with the Back or Forward button. And the on-screen image quality tends to be inferior to that of TEX-created GIFs. Nevertheless this looks like a promising tool for authors of mathematical documents, particularly as computer power continues to increase.

**Mathematica** Mathematica is an application for doing numerical, algebraic, and graphical computations using a symbolic language designed specifically for the purpose. Recent releases of Mathematica have included improved mathematical fonts and greater typesetting power (look for references to "Publicon"); it therefore seems to be growing more viable as a way of producing mathematical documents. I have not had the opportunity to work with Mathematica myself, but if you know someone who has a copy you might like to check it out as a possible alternative to TEX. I don't think its typesetting facilities are quite up to the task of producing a typical book yet, but at any rate it is getting closer.

http://www.wolfram.com/

**MathType** MathType is a powered-up version of the equation editor used in WordPerfect, Microsoft Word, and other word processors. There are versions for the usual Windows and Macintosh platforms. You write an equation in a MathType window and then transfer it into your document using one of the standard formats for your platform (e.g., WMF, OLE, EPS). For more details see

http://www.mathtype.com/

MathML capabilities were recently added:

> MathType 4.0 can generate MathML for use in authoring Web pages with mathematics. It will do so via a new translator mechanism. Translators are defined using a simple language and may be customized by the end user. Several MathML translator definition files are supplied with MathType 4.0 and will produce MathML presentation tags.

**Scientific Workplace and Scientific Word** Scientific Word is a word processing system with extraordinary capabilities for handling mathematical formulas. It might be compared to, say, WordPerfect if WordPerfect had the MathType equation editor fully integrated into the editing interface. Scientific Workplace is Scientific Word with an embedded interface to the Maple computer algebra system so that you can evaluate expressions, plot functions, and so on from *within* the Scientific Workplace document window. In addition, the typesetting capabilities of Scientific Word/Workplace are essentially the same as those of /, because it uses / as its file format when saving documents, and printing is done by running the document through /.

http://www.mackichan.com/