Using the *MathTımeProfessional* fonts with LaTeX*

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Abstract

This document describes the macro package mtpro, which serves for using version 3 of the the *MathTımeProfessional* fonts with LaTeX. The package code was partially adopted from the mathtime package written by Frank Mittelbach and David Carlisle.

Contents

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*This document refers to version v3.3 of the mtpro package.

1 The *MathTımeProfessional* fonts

MathTımeProfessional is a set of math fonts particularly designed for use with
TEX or LATEX.

Separate fonts for text size, superscripts, and second order superscripts are
provided, allowing quality mathematical typesetting that has hitherto been avail-
able only with metal type or with the Computer Modern and the Euler fonts. Fur-
thermore, *MathTımeProfessional* includes individually designed delimiters and
roots for sizes up to 4 inches and extrawide mathematical accents.

With the release of version 2, additional bold and extra bold math fonts were
made available. With version 3, a full upright Greek alphabet was added, as well
as additional multiple, line and surface integral signs and extra large operator
symbols

2 The mtpro package

Basically, loading the macro package mtpro

> `\usepackage[`⟨*options*⟩`]{mtpro}`

makes LATEX use *MathTımeProfessional* in place of the default Computer Modern
math fonts. The following sections describe the particular features of the package
and the additional options that control its behavior.

2.1 Text fonts

Loading the mtpro package does not change LATEX's default text font families
(Computer Modern). However, the *MathTımeProfessional* fonts were designed
to blend best with Times. The Monotype Times New Roman fonts are an ideal
match, but mtpro can equally well be used with Adobe Times and similar type-
faces, such as Times Ten, and also turns out to work quite well with other text
fonts, like Baskerville or Concorde.

The roman, sans-serif and typewriter font families and the encoding of the
text fonts are to be selected *before* loading of mtpro (unless you stay with LATEX's
defaults), so that the package 'knows' the fonts and the encoding to be used for
operator names such as 'sin' and for the math alphabets `\mathrm`, `\mathsf` and
`\mathtt`. For instance,

```
\usepackage[T1]{fontenc}
\usepackage{textcomp}
\renewcommand{\rmdefault}{ptm}
\usepackage[scaled=0.92]{helvet}
\usepackage{mtpro}
```

selects T1 encoding with additional text companion symbols and loads
MathTımeProfessional in conjunction with Adobe Times (`ptm`) and Helvetica,
while the default typewriter font family (CM Typewriter) is unchanged. This is
how the present document has been typeset.

2.2 Greek letters

With TeX or LaTeX, uppercase Greek letters in math mode are usually typeset as upright, even though they are usually meant to designate variables. Since this violates the International Standards ISO31-0:1992 to ISO31-13:1992, the mtpro package provides an option slantedGreek, which causes uppercase Greek (\Gamma, \Delta etc.), to be typeset as slanted.

Upright lowercase and uppercase Greek letters are available with command names such as \upalpha, \upbeta, \upGamma, \upDelta, etc. They are always upright, regardless of the slantedGreek option.

2.3 Numbers and punctuation in math mode

LaTeX's default behavior is to typeset numbers and punctuation in math mode using the \mathrm alphabet, which normally equals the default text font.

With the mtpro package, in contrast, numerals and punctuation characters are—in math mode—taken from the *MathTimeProfessional* fonts. Thus, entering 1.23 will yield a different result than 1.23, and you will have to decide in each case whether an input fragment is a math or a non-math entity.

2.4 Calligraphic alphabet

The *MathTimeProfessional* fonts do not include a calligraphic alphabet, so \mathcal defaults to the calligraphic font of the Computer Modern family. The calligraphic fonts from the LucidaNewMath or Euler families are a better choice—provided that these fonts are available in your TeX system. Specifying the package options lucidacal or eucal makes \mathcal use these instead of CM.

Section 3 lists further options to set up \mathcal or an additional math alphabet \mathscr. They are somewhat confusing and are provided only for the sake of compatibility with the old mathtime package; using them in new documents is not recommended.

2.5 Letters for number sets

Loading the mtpro package with the option amsbb makes the AMS symbol font 'msbm' available as a 'blackboard bold' math alphabet \mathbb. Of course, other blackboard bold fonts can be used by loading of appropriate packages. In that case, do not select the amsbb option!

2.6 Bold math fonts

2.6.1 Emboldening complete formulas

The declaration \boldmath will embolden all formulas within its scope, just as with the standard CM math fonts. Use it, for instance, to emphasize complete formulas or to make sure that mathematical expressions within bold section titles also appear in bold type. Bold formulas should, however, not contain the

extra large parentheses, roots and operators described in section 2.8 below. The
`\wide...` accents (2.9) cannot be emboldend, either.

2.6.2 Bold letters and symbols

The declaration `\boldmath` cannot be issued when you are already in math mode.
Thus it is not a suitable means to embolden single letters, e.g., if you want to
designate vectors with bold type. This use of bold letters in formulas is supported
through a number of bold *math alphabets*:

> ▷ `\mathbf` prints its argument using the **bold upright** text font.

> ▷ `\mbf` is similar, but uses a specially modified version of the bold upright
> Times font, with the spacing and the letter shapes adapted to math typeset-
> ting. Thus `\mbf` is appropriate to typeset single variables, while `\mathbf`
> can be used, e.g., to emphasize an operator name.

> ▷ When the package is loaded with the option boldalphabet, an additional
> ***bold italic*** math alphabet named `\mathbold` is provided—something that
> isn't easily available with standard LATEX. In contrast to `\mathbf` and `\mbf`,
> this alphabet includes also Greek letters.[1]

> ▷ Beside the usual `\mathcal` there is also a bold variant `\mathbcal`.

> ▷ When a `\mathscr` alphabet is set up through the options lucidascr or mt-
> plusscr, a corresponding bold `\mathbscr` is defined, too.

An *alternative* to the use of several different bold math alphabets is available
through the macro package bm. It defines the command `\bm`, which can embolden
not only letters but also symbols or arbitrary expressions—provided that the re-
quired fonts exist. The package bm belongs to the tools collection, which is part
of every LATEX system. *It is highly recommended to read the documentation of
the package before using it!* The command `\bm` should not be used on constructs
like `\PARENS` or `\SQRT` or the `\wide...` accents.

2.6.3 'Heavy' symbols

Most—but not all—of the mathematical symbols of the *MathTimeProfessional*
fonts exist also in a 'heavy' (i.e., extra bold) variant, which can be used through
the command `\hm` of the above-mentioned package bm.[2] To recognize the exis-
tence of the 'heavy' fonts, the package bm must be loaded *after* mtpro!

The 'heavy' symbols are darker and more prominent than the 'bold' ones, so
they are suitable, for instance, if you need an extra bold plus sign with a different
mathematical meaning than the regular $+$. Applying `\hm` to characters that are not
available as 'heavy' yields either normal type or a 'slug' (a black box), depending
on the math alphabet. In particular, this restriction affects Latin and Greek letters,
as well as the 'extra large' delimiters, root, operators and accents described below.

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[1]The shape of the uppercase Greek letters follows the slantedGreek option.

[2]Use of the corresponding `\heavymath` declaration is, however, pointless, because the heavy
math fonts are incomplete.

2.7 Positioning of subscripts

The appearance of subscripts can be improved by loading the package with the option subscriptcorrection. When certain letters, like f or j, occur as a subscript, the positioning will be automatically adjusted. In the following example, the left sum was typeset with subscript correction, the right one without:

$$C_f + C_j + X_A \qquad C_f + C_j + X_A$$

The \enablesubscriptcorrection and \disablesubscriptcorrection commands can also be used to turn subscript correction on and off within the document.

No guarantee is made as to the proper functioning of the automatic subscript correction in conjunction with any additional macro package, because the underscore character _ is made active.

2.8 The big differences

2.8.1 Extra large delimiters and roots

The *MathTimeProfessional* font set includes individually designed parentheses and other delimiters which go up to to 4 inches high.

The large parentheses are produced by the command \PARENS{...}; just compare the left matrix with the output obtained from the ordinary \left(and \right(macros:

$$\begin{pmatrix} x_{11} & x_{12} & \cdots \\ x_{21} & x_{22} & \cdots \\ x_{31} & x_{32} & \cdots \\ \vdots & \vdots & \ddots \end{pmatrix} \qquad \begin{pmatrix} x_{11} & x_{12} & \cdots \\ x_{21} & x_{22} & \cdots \\ x_{31} & x_{32} & \cdots \\ \vdots & \vdots & \ddots \end{pmatrix}$$

Basically, \PARENS{...} is just an abbreviation for \LEFTRIGHT(){...}. In general, you can use \LEFTRIGHT directly with any two delimiters, including the period for an empty delimiter. In addition to parentheses, you can get /, \backslash, < (or \langle), and > (or \rangle), all up to 4 inches high.

A combination like \LEFTRIGHT(] is also possible; the] just gets extended in the usual way. At large sizes, however, the (might end up slightly larger than the], since the] grows at the same (6 pt) rate, no matter how large the argument, while the parentheses grow faster for larger formulas. So in such cases it might be desirable to add a 'strut' (i.e. a construction of the form \rule{0pt}{⟨*height*⟩}) to the formula to force a larger] symbol.

In addition to the \sqrt command, which uses an 'extensible' symbol, mtpro provides \SQRT, with the same syntax. It produces individually designed root signs up to 4 inches high: In the example below, the left root was typeset using \SQRT, the right one results from the ordinary \sqrt command.

$$\sqrt[3]{\sum_{i=1}^{n} (y^i - x^i)^3} \qquad \sqrt[3]{\sum_{i=1}^{n} (y^i - x^i)^3}$$

The positioning of the root index can be adjusted through the commands `\LEFTROOT` and `\UPROOT`. They are to be issued in math mode, they are valid inside the current formula only, and they act only on roots produced from `\SQRT`. Positive arguments to these commands will move the root index to the left and up respectively, while a negative argument will move it to the right and down. The units of increment are quite small, which is useful for such adjustments. In the example below, the index β of the left root is moved 2 units to the right and 6 units up by saying `\LEFTROOT{-2} \UPROOT{6} \SQRT...`; the right root shows the default appearance:

$$\sqrt[\beta]{k} \qquad \sqrt[\beta]{k}$$

Notice that the syntax of the `\LEFTROOT` and `\UPROOT` commands differs both from the amsmath package and from `mtp.tex`!

You can nest `\PARENS` (or `\LEFTRIGHT`), though of course that shouldn't be needed very often. Doing so slows TeX down exponentially and may also exhaust its capacity. It should also be mentioned that `\PARENS` ends up typesetting its argument more than once, in order to find out the right size of the delimiters, so you need to be careful when using boxes: For example, if you have stored a formula in `\box\eqnbox`, then you should be sure to type `\PARENS{\copy\eqnbox}`, rather than `\PARENS{\box\eqnbox}`. The same precaution applies to `\SQRT` and to the new `\wide...` accents explained in section 2.9.

2.8.2 Extra large operator symbols

In a displayed formula like

$$\sum_{i \notin I} \frac{\displaystyle\int_{-\infty}^{+\infty} f(\alpha_i x)\, dx + 1}{\displaystyle\oint_C f(\beta_i z)\, dz - 1}$$

you might feel the need for a larger sum sign. Normally printers don't provide one, but with the *MathTimeProfessional* fonts you can get an extra large `\sum` with the `\XL` command. For instance, `\XL{i \notin I}{}\sum...` yields:

$$\sum_{i \notin I} \frac{\displaystyle\int_{-\infty}^{+\infty} f(\alpha_i x)\, dx + 1}{\displaystyle\oint_C f(\beta_i z)\, dz - 1}$$

Notice that the limits are to be given as the first two arguments of `\XL`, rather than as a subscript and superscript to `\sum`. The two arguments *must* appear, even if one, or both, are empty: `{}`.

All 'large operators' (`\sum`, `\int`, `\prod`, etc.) are available as `\XL` versions. They are a half inch (36 points) tall, except for the extra large `\bigcupprod` and `\bigcapprod` (see section 2.10) which are shorter, just as `\bigcupprod` and

`\bigcapprod` are shorter than `\bigcup` and `\bigcap`. There are also `\XXL` versions that are a full inch high! And, heaven forbid, you can even get `\XXXL` versions that are two inches high, thereby assuring yourself (as well as the designer of the MathTime fonts) the lasting enmity of journal editors everywhere.

You can use `\XLNL` if you want 'no limits', i.e., if you'd like these limits set as subscripts and superscripts. For instance, `\XLNL{a}{b}\int` prints:

$$\int_a^b$$

2.9 Accents in math

In addition to `\widehat` and `\widetilde`, there is now `\widecheck`. The `\widehat`, `\widecheck`, and `\widetilde` accents are extended in a similar fashion as the large delimiters and roots (see above); in each case you can get accents up to 4 inches wide:

$$\widehat{a+b} + \widehat{a+b+c} + \widehat{a+b+c+d} + \widehat{a+b+c+d+e}$$

In a combination like $\hat{A}$, the `\hat` accent might look a little small, while `\widehat` produces an accent $\widehat{A}$ that looks too large. So there is `\what` to produce a slightly wider hat accent, $\hat{A}$. Similarly, there are `\wtilde`, `\wcheck`, and `\wbar`.

In addition, there are slightly larger `\wwhat`, `\wwcheck`, `\wwtilde`, and `\wwbar`. The `\wwhat`, `\wwcheck`, and `\wwtilde` accents are identical to the smallest versions of the accents produced by `\widehat` etc., but in some cases it might be preferable to force this smallest size instead of relying on the `\wide...` accents themselves. For example, `\widehat M` yields $\widehat{M}$, because the M (counting the white space on its sides) happens to be just a bit too wide for the smallest `\widehat` accent, whereas `\wwhat M` will result in $\widehat{M}$.

The `\wwbar` accent is what used to be called `\widebar` in the *MathTime* fonts, but that really wasn't a very good name, since `\overline` is what actually corresponds to the `\wide...` accents.

The standard commands `\dot` and `\ddot` are complemented with ready-made triple and quadruple dot accents `\dddot` and `\ddddot`; they work with or without the amsmath package.

In situations like $\dot{\Gamma}$, the dot accents might look better if they were moved up a bit. So there are `\dotup`, `\ddotup`, `\dddotup` and `\ddddotup`, to produce $\dot{\Gamma}$, $\ddot{\Gamma}$ etc.

2.10 Additional symbols not available with standard LaTeX

2.10.1 Integrals

The *MathTimeProfessional* fonts include multiple, surface and line integrals. They are available in text size (as shown in the below table) as well as display size:

$\iint$	\iint	$\iiint$	\iiint	$\oiint$	\oiint	$\oiiint$	\oiiint
$\oint$	\cwoint	$\oint$	\awoint	$\oint$	\cwint		

The macros are compatible with the amsmath package, which may be loaded additionally.

2.10.2 Negated relation symbols

MathTımeProfessional includes a number of ready-made negated relation symbols, which are normally built from pieces. For instance, with *MathTımeProfessional* you should write \notleq instead of \not\leq:

$\not<$	\notless	$\not>$	\notgr	$\neq$	\neq
$\not\leq$	\notleq	$\not\geq$	\notgeq	$\not\equiv$	\notequiv
$\not\prec$	\notprec	$\not\succ$	\notsucc	$\not\sim$	\notsim
$\not\preceq$	\notpreceq	$\not\succeq$	\notsucceq	$\not\simeq$	\notsimeq
$\not\subset$	\notsubset	$\not\supset$	\notsupset	$\not\approx$	\notapprox
$\not\subseteq$	\notsubseteq	$\not\supseteq$	\notsupseteq	$\not\cong$	\notcong
$\not\sqsubseteq$	\notsqsubseteq	$\not\sqsupseteq$	\notsqsupseteq	$\not\asymp$	\notasymp

2.10.3 Miscellaneous symbols

The *MathTımeProfessional* fonts provide various operator symbols and Greek letters, which are not defined with standard LaTeX:

<div align="center">

Binary operators

$\cap$	\capprod	$\cup$	\cupprod
$\circ$	\comp	$\smallsetminus$	\setdif

Large operators

$\bigcap$	\bigcapprod	$\bigcup$	\bigcupprod

Letters

β	\varbeta	β	\upvarbeta
∂	\vardelta	∂	\upvardelta
$\varkappa$	\varkappa	$\varkappa$	\upvarkappa

</div>

The above table shows \bigccapprod and \bigcupprod as they would appear within inline formulas. Being 'large operators', they are enlarged when used within displayed formulas:

$$\bigcap_{i=1}^{n}\alpha_i \qquad \bigcup_{i=1}^{n}\alpha_i$$

\varbeta and \vardelta are old forms of β and δ that you might find useful if you are trying to imitate certain old books. Notice that \vardelta is hardly distinguishable from the \partial symbol (the circular portion of \vardelta is taller, to match the height of letters like x and o in math formulas). The only reason for providing \vardelta is that all the various Greek alphabets specified

for mathematics in the Unicode standard include this variant (perversely called 'partial').

The bold or heavy versions of ♠ and ♣ are somewhat grotesque. If you need to have different varieties of these, you might like to use the following ones:

| ♤ | \openspadesuit | ♠ | \shadedspadesuit |
| ♧ | \openclubsuit | ♣ | \shadedclubsuit |

Notice, however, that the open and shaded symbols themselves have no bold or heavy counterparts!

2.11   Change history

Version 3.3 as of 2004-05-21, to be used with version 3 of the fonts:

▷ non-bold upright Greek letters

▷ additional operator symbols and variant Greek letters

▷ \XL, \XXL and \XXXL operators.

▷ additional integrals signs

Version 3.0 as of 2004-01-07, to be used with version 2 of the fonts:

▷ The new bold and heavy *MathTımeProfessional* fonts can be used via \boldmath or the package bm.

▷ Additional math symbols and multiple dot accents are made available.

▷ \mathbold now acts on uppercase Greek, too, and the shape of the bold uppercase Greek letters follows the slantedGreek option.

▷ A full upright Greek alphabet is supported (but the lower-case letters are available only with bold weight).

▷ New option eucal to use Euler Script as \mathcal. This has a few advantages over using the external package eucal.

Version 2.0.16 as of 2003-12-12:

▷ The (undocumented) options OT1, T1, LY1 and noTS1 have been abolished.

▷ A new option boldalphabet controls whether the math alphabet command \mathbold is made available.

3   Option summary

This section lists all options of the mtpro package. Options that correspond to the default behavior of the package are marked by an asterisk and need normally not to be specified.

uprightGreek* Makes the uppercase Greek letters upright.

slantedGreek Makes the uppercase Greek letters slanted.

subscriptcorrection Redefines the underscore character so that it automatically corrects the spacing of subscripts.

nosubscriptcorrection* Disables the subscript correction.

amsbb Defines `\mathbb` to refer to the blackboard bold math alphabet from the AMS fonts.

boldalphabet Defines `\mathbold` to refer to a bold italic math alphabet.

cmcal* Uses the Computer Modern calligraphic alphabet for `\mathcal` and `\mathbcal`.

eucal Sets up `\mathcal` and `\mathbcal` to use the Euler script fonts.

lucidacal Sets up `\mathcal` and `\mathbcal` to use the Lucida calligraphic fonts

lucidascr Like lucidacal, but puts the fonts into `\mathscr` and `\mathbscr`.

mtplusscr Sets up `\mathscr` and `\mathbscr` to use the MTMS and MTMSB script fonts, which are part of Y&Y's *MathTıme* Plus collection.

mtpluscal Like mtplusscr, but puts the fonts into the `\mathcal` and `\mathbcal` alphabets.

This package makes a lot of font re-assignments. Normally these generate warning messages on the terminal, however getting so many messages would be distracting, so a further three options control the font tracing. Even more control may be obtained by loading the tracefnt package.

errorshow* Only show font *errors* on the terminal. Warnings are just sent to the log file.

warningshow Show font warnings on the terminal. This corresponds to the usual LATEX behavior.

nofontinfo Suppress all font warnings, even from the log file.

NB: Not all options can be used together, e.g., one can at most select one of the options setting up `\mathcal`: If more than one option is given, eucal will win over mtpluscal and lucidacal.
NB: The options lucidascr or mtplusscr must not be used, when an additional package is loaded to set up a `\mathscr` alphabet.