

Using the *MathTimeProfessional* fonts with L^AT_EX*

Walter Schmidt

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Abstract

This document describes the macro package `mpro`, which serves for using the *MathTimeProfessional* fonts with L^AT_EX. The package code was partially adopted from the `mathtime` package written by Frank Mittelbach and David Carlisle.

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1 The *MathTimeProfessional* fonts

MathTimeProfessional is a set of math fonts particularly designed for use with T_EX or L^AT_EX. They come with a licensed copy of the corresponding text fonts ‘Times New Roman’ from Monotype.

*This document refers to version v2.0.14 of the `mpro` package. Development of this package was commissioned by Y&Y.

Separate fonts for text size, superscripts, and second order superscripts are provided, allowing quality mathematical typesetting that has hitherto been available only with metal type or with Knuth's CM and Euler fonts. Furthermore, *MathTimeProfessional* includes individually designed delimiters and roots for sizes up to 4 inches and extrawide mathematical accents.

For a detailed discussion of the *MathTimeProfessional* fonts see the document 'Brief Guide to the New *MathTimeProfessional* Fonts', file `mtpguide.pdf`.¹

2 The mtpro package

Basically, loading the macro package `mtpro`

```
\usepackage[options]{mtpro}
```

makes L^AT_EX use Times NRMT and *MathTimeProfessional* in place of the default Computer Modern 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 changes L^AT_EX's default roman font family to `mtm`, i.e., Monotype Times New Roman (Times NRMT), since the *MathTimeProfessional* fonts were particularly designed to blend with this one.

The font family `mtm` is available with LY1, OT1, T1 and TS1 encoding. In NFSS terms, the series `m` (regular) and `b` (bold) and the shapes `n` (normal) and `it` (italic) are available.

The *MathTimeProfessional* fonts can be used in conjunction with other text font families than Times NRMT, too. This is accomplished by changing the default roman font family, i.e., the macro `\rmdefault`, from its default value `cmr` before loading the `mtpro` package; as a result, the package will not alter it once again. For instance,

```
\renewcommand{\rmdefault}{pttx}  
\usepackage{mtpro}
```

will use TimesTen (with real smallcaps) for text and *MathTimeProfessional* for math.

The `mtpro` package does not change the default sans serif and typewriter font families. At least Computer Modern Sans does, however, not blend well with Times. If you are restricted to the fonts that are available with any L^AT_EX system, you may use Helvetica instead:

```
\usepackage[scaled=0.93]{helvet}  
\usepackage{mtpro}
```

Note that Helvetica should be scaled down to 90...95% of its 'natural' size so as to match Times NRMT.²

¹Sections 2.9 and 2.10 were partially adopted from that document.

² This requires at least PSNFSS 8.1, as distributed with L^AT_EX since June 2000.

2.2 Text fonts in math

The default roman text font, as indicated by the value of `\rmdefault`, is used for the math alphabet `\mathrm`; function names, too, are typeset using that font.

The math alphabets `\mathsf`, `\mathit` and `\mathtt` are mapped to the default sans serif, italic and typewriter text fonts by evaluating the macros `\sfdefault`, `\itdefault` and `\ttdefault` when `mtpro` gets loaded. Thus, if you redefine the default text fonts this should be done *before* loading `mtpro`—see the previous section.

The above-mentioned math alphabets are used with the default text font encoding, which is determined from the meaning of the macro `\encodingdefault` when `mtpro` gets loaded. Alternatively, one can force `mtpro` to use one of LY1, T1 or OT1 by specifying it as a package option, e.g.:

```
\usepackage[T1]{mtpro}
```

Doing so may be useful, if you change the encoding for the text fonts *after* loading of `mtpro`, in order to prevent L^AT_EX from accessing the default CM fonts with an encoding that is possibly not available with CM.

2.3 Numbers and punctuation in math mode

L^AT_EX'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. These numerals are somewhat smaller than those from Times NRMT and seem to be more appropriate for use in formulas. Entering `1.23` will, however, yield a different result than `1.23` then, and you will in each case have to decide whether an input fragment is a math or a non-math entity.

2.4 Greek letters

With T_EX or L^AT_EX uppercase Greek letters in math mode are usually typeset as upright, despite they are usually meant to designate variables. This violates clearly the International Standards ISO31-0:1992 to ISO31-13:1992.

The `mtpro` package provides an option `slantedGreek`, which causes uppercase Greek to be typeset as slanted. Regardless of the option, the commands `\upDelta` and `\upOmega` will always produce an upright Δ and Ω , because these symbols might be required in upright shape, too.

2.5 Calligraphic and script alphabets

The *MathTimeProfessional* fonts don't include a calligraphic alphabet, so `\mathcal` defaults to the calligraphic font of the Computer Modern family.

The calligraphic fonts from the *MathTime Plus* or *Lucida* families are a better choice—provided that you have actually got these fonts! Specifying the package options `mtpluscal` or `lucidacal` makes `\mathcal` use these instead of CM. Alternatively, the package options `mtplusscr` or `lucidascr` define them as `\mathscr` rather than `\mathcal`.

2.6 Blackboard bold

Loading the `mpro` package with the option `amsbb` makes the AMS symbol font ‘`msbm`’ available as a ‘blackboard bold’ math alphabet `\mathbb`. This may be useful, because the `amsfonts` or `amssymb` macro packages cannot be loaded in conjunction with `mpro`—see section 2.13.

Of course, other blackboard bold fonts can be used alternatively, through loading of the related packages; do not select the `amsbb` option then.

2.7 Bold math fonts

The command `\boldmath`, which is normally used to darken complete formulas, has no effect when the `mpro` package is used, because the *MathTimeProfessional* font set does not include the required bold math fonts. One may think of using the bold *MathTime Plus* fonts or even Computer Modern instead, but this will not work, due to the different font layout: One would end up with, e.g., Greek letters in place of numerals! However, the `mpro` package provides a sophisticated choice of bold math alphabets, which are perhaps of much more use:

- ▷ `\mathbf` is the **bold upright** Latin math alphabet. In contrast to L^AT_EX’s normal behavior, `mpro` doesn’t simply use the bold variant of the text font here; instead, a modified version of bold Times is used, with the spacing and the letter shapes particularly adapted to math typesetting.

- ▷ `\mathbold` is a **bold italic** math alphabet—something that isn’t easily available with standard L^AT_EX. `\mathbold` acts on both Latin and Greek letters.

By default, the bold italic math font from Computer Modern will be used for `\mathbold`. If you have got the *MathTime Plus* font set, you should load the `mpro` package with the option `mtbold`, thus using the font MTMIB instead, which suits the other Times fonts.³

- ▷ In addition to `\mathcal` there is also a bold variant `\mathbcal`.

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

2.8 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:

$$C_f + C_j + X_A \quad C_f + C_j + X_A$$

Subscript correction can also be turned on and off within the document using the commands

`\enablesubscriptcorrection` and `\disablesubscriptcorrection`.

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.

³Of course, `\mathbold` acts only on symbols, which are *not* affected by the different encoding of the bold *MathTime Plus* fonts!

2.9 Large delimiters and roots

The *MathTimeProfessional* font set includes individually designed parentheses and other delimiters with sizes up to 4 inches high

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

$$\left(\begin{array}{ccc} x_{11} & x_{12} & \dots \\ x_{21} & x_{22} & \dots \\ x_{31} & x_{32} & \dots \\ \vdots & \vdots & \ddots \end{array} \right) \quad \left(\begin{array}{ccc} x_{11} & x_{12} & \dots \\ x_{21} & x_{22} & \dots \\ x_{31} & x_{32} & \dots \\ \vdots & \vdots & \ddots \end{array} \right)$$

You can nest `\PARENS` though of course that shouldn't be needed very often. Note that `\PARENS` ends up typesetting its argument more than once, in order to find out the right size of the delimiters, so nesting slows \TeX down exponentially and may also exhaust its capacity.

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}{\langle height \rangle}`) to the formula to force a larger `]` symbol.

In addition to the `\sqrt` command, which uses an 'extensible' symbol, `mpro` 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.

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

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`.⁴ Positive arguments to these commands will move the root index to the left and up respectively, while a negative argument will move it 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:

$$\overset{\beta}{\sqrt{k}} \quad \sqrt[3]{k}$$

2.10 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 than the

⁴Caution: The syntax differs both from the `amsmath` package and `mtp.tex`!

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, \widehat{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 happens to be just too wide (counting the white space on its sides) 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.

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

2.11 Additional symbols

The `mtpro` package provides a few additional math symbols, which are not defined with standard `LATEX`:

$$\begin{array}{llll} \cup & \backslash\cupprod & \circ & \backslash\comp \\ \cap & \backslash\capprod & \varkappa & \backslash\varkappa \end{array} \quad \setminus \backslash\setdif$$

These are binary operators, except for `\varkappa` which is of type 'mathalpha'.

2.12 Symbols missing from the *MathTimeProfessional* fonts

The *MathTimeProfessional* fonts do not include the symbols †, ‡, ¶ and §. As a workaround, the `mtpro` package will redefine the related commands so as to use the text companion fonts (i.e., TS1 encoding), unless you are using the LY1 encoding, which *does* provide the symbols in question. This affects both text and math mode.

Loading the package with the option `noTS1` suppresses that behavior. Doing so may be useful, if your text fonts are not available with TS1 encoding anyway, or if you don't want to waste one of the 16 math symbol fonts just for these symbols.

2.13 Known problems

- ▷ The macro package `amsmath`, formerly known as `AMS-LATEX`, applies a lot of changes to `LATEX`'s math typesetting facilities. Unfortunately, these changes rely partially on the characteristics of the Computer Modern math fonts. As a result, the `\boldsymbol` command will not work with the *MathTimeProfessional* fonts.
- ▷ The packages `amssymb` and `amsfonts` cannot be used in conjunction with `mtpro`. Note, however, that you may still load the `eufrak` and `eucal` packages to use the Euler Fraktur and script fonts. As to the blackboard bold alphabet see section 2.6.

A Option summary

This section lists all options of the mpro 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.

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

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 Math Time Plus script fonts.

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

mtbold Uses the bold italics from the *MathTime* Plus fonts for the `\mathbold` alphabet.

cmbold* Like `mtbold`, but uses the bold math italic font from Computer Modern.

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

noTS1 Stops the package from using any text companion fonts for missing math symbols.

OT1 Uses OT1 encoding for the operators font.

T1 Uses T1 encoding for the operators font.

LY1 Uses LY1 (Y&Y's 'locally' defined texansi encoding) in the operators font. This option includes also the effect of `noTS1`, since the symbols in question are provided in the LY1 encoding; you need not specify `noTS1` additionally.

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 `tracefmt` 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 L^AT_EX behavior.

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

Not all options can be used together, e.g., one can at most select one of the options setting up `\mathcal`. If both options are given `mtpluscal` will win over `lucidacal` and in case of `\mathscr`, `lucidascr` will be the winner over `mtplusscr`.