
**Euler-VM: Generic math fonts for use with
L^AT_EX**

Walter Schmidt

Abstract

The Euler math fonts are suitable for math typesetting in conjunction with a variety of popular text fonts which do not provide math character sets of their own. Euler-VM is a set of virtual fonts based on Euler and Computer Modern, accompanied by a macro package for easy use with L^AT_EX.

The Euler math fonts

“With Donald Knuth’s assistance and encouragement, Hermann Zapf, one of the premier font designers of this century, was commissioned to create designs for Fraktur and script, and for a somewhat experimental, upright cursive alphabet that would represent a mathematician’s handwriting on a blackboard and that could be used in place of italic. The designs that resulted were named Euler, in honor of Leonhard Euler, a prominent mathematician of the eighteenth century. Zapf’s designs were rendered in METAFONT code by graduate students at Stanford, working under Knuth’s direction. [...] Knuth also noticed that the style of some symbols in the Computer Modern extension font, in particular the integral sign, was too slanted to be attractive with Euler, and consequently he prepared a new (partial) extension font for use with Euler.” [3]

Knuth’s book *Concrete Mathematics* [1] was typeset using the Concrete font family for text and the Euler fonts for the formulas. With L^AT_EX, the particular math font setup of this book can be mimicked through the package `euler.sty` [2]. Later it became obvious that the Euler math fonts match other text font families equally well.

Unfortunately, the Euler fonts do not comprise all symbols required for mathematical typesetting with L^AT_EX. As a result, the `euler` package needs to redefine most of L^AT_EX’s math font setup, so that certain symbols are taken from Euler, whereas others come from Computer Modern. This has resulted in many problems and prevented the widespread use of the package beyond its initial purpose.

A new interface to the Euler fonts

Euler Virtual Math (Euler-VM) is a set of *virtual* fonts based primarily on the Euler fonts. The missing symbols are “stolen” from Computer Modern through the virtual font mechanism, rather than at T_EX level, and the encoding follows that of the classical Computer Modern math fonts as far as possible. This approach has several advantages over immediately using the *real* Euler fonts, as implemented in the `euler` package. Most noticeably, less T_EX resources are consumed, the appearance of various math symbols is improved, and there are (almost) no more compatibility problems with other packages. Thus, Euler-VM constitutes, together with the related macro package `eulervm`, a “generic” math font set for L^AT_EX.

The initial reason for creating Euler-VM was the fact that the `euler` package does not provide a usable `\hbar` or `\hslash`, and the `\hslash` from

the `amssymb` package cannot be used, because the latter follows the CM Roman style (rather than matching Euler). This made the beautiful Euler fonts essentially unusable for physics and related fields. The only way to fix this was to provide a “faked” Euler-style `\hslash` through the virtual font mechanism. As a beneficial side effect, it was possible to make the layout of the new virtual fonts compatible with Computer Modern Math to a large extent, and—since the style file had to be rewritten anyway—many further improvements were introduced.

Typographical considerations

From a technical point of view, the Euler fonts can be used together with arbitrary text fonts. From a typographical point of view, however, it is obvious that this will not always yield an attractive result. In particular, using Euler with Computer Modern is not a good idea at all!

Beside the above-mentioned “Concrete”, the typeface families Palatino, Aldus and Melior blend well with Euler. This is not surprising, since they were also designed by H. Zapf. One might think of using Optima with Euler, but the typefaces are too similar, thus making formulas hard to read.

The Euler math fonts have also proven to go sufficiently well with other typefaces, such as Minion, that exhibit a similar weight (stroke width) and x-height.

Unfortunately, the popular “Garamond-style” typefaces Adobe Garamond and Stempel Garamond do *not* go well with Euler, because their x-height is too small. A Garamond descendant that yields a more pleasing result together with Euler is Sabon, because of its somewhat larger x-height.

Using the Euler math fonts in conjunction with a *sans serif* typeface for text is possible, too. The only sans serif typeface which I know so far to work well is “Syntax”; of course there may be others.

The L^AT_EX macro package `eulervm`

Loading the `eulervm` package redefines L^AT_EX’s math font setup, so that the Euler-VM fonts and the default body font are substituted for CM Math and CM Roman. Roughly:

- CM Math Italic is replaced with Euler Roman.
- CM Calligraphic is replaced with Euler Script.
- “Large” operators and delimiters are replaced with alternative symbols matching the Euler style.
- In numbers and operator names, CM Roman is replaced with the default text font.

The model has the parameters f_i , E_i , C and r ($0 \leq r \leq 1$). The oscillator strengths f_i and the atomic level energies E_i should satisfy the constraints

$$f_1 + f_2 = 1 \quad (1)$$

$$f_1 \ln E_1 + f_2 \ln E_2 = \ln I \quad (2)$$

The parameter C can be defined with the help of the mean energy loss dE/dx in the following way: The numbers of collisions (n_i , $i = 1, 2$ for the excitation and 3 for the ionisation) follow the Poisson distribution with a mean number $\langle n_i \rangle$. In a step Δx the mean number of collisions is

$$\langle n_i \rangle = \Sigma_i \Delta x \quad (3)$$

The mean energy loss dE/dx in a step is the sum of the excitation and ionisation contributions

$$\frac{dE}{dx} = \left[\Sigma_1 E_1 + \Sigma_2 E_2 + \Sigma_3 \int_I^{E_{\max}+I} E g(E) dE \right] \quad (4)$$

Figure 1: Using the Palatino typeface for text and the Euler fonts for the formulas via the package `eulervm`.

For instance, to use Palatino for text and Euler for the formulas, you would need only the following commands:

```
\renewcommand{\rmdefault}{ppl}
\usepackage{eulervm}
```

Figure 1 shows an example, using these typefaces.

The packages `amssymb` or `eufrak` can be loaded to provide extra math symbols and the Euler Fraktur letters, and `eulervm` is also fully compatible with `AMS-LATEX`, i.e., `amsmath.sty`.

The package provides a number of options and non-standard facilities which are described in detail in the accompanying documentation. The present article will focus only on two features:

Scaling Loading the package with the option `small` causes the Euler fonts to be loaded at 95% of their nominal size, thus blending better with certain text font families, for instance Aldus or Minion. The option acts also on the AMS symbols and Euler Fraktur fonts; any other math fonts used in the document remain unaffected.

Numbers and punctuation The normal behavior of the `eulervm` package is to take the digits, the comma and the period in math mode from the default text font family. Text fonts are, however, not always suitable for typesetting math: The digit “1” may not be distinguishable clearly enough from the letter “l”, or the style of the digits may not mesh well with the Euler letters. Furthermore, most text fonts are scaled linearly, so that the digits may become too thin when used in super- or subscripts.

As a workaround the `eulervm` package provides the option `euler-digits`, which makes the digits, the comma and the period come from Euler Roman in math mode. Since the Euler fonts are available with designs sizes of 10 pt, 7 pt and 5 pt, no problems are to be expected in super- and subscripts! The option should be used with care, because the input `1.23` will then yield a different result than `1.23`, and thus one will in each case have to decide whether an input fragment is a mathematical or a non-mathematical entity. The example shown as figure 1 was created using this option.

Availability

The Euler fonts are supplied with all modern `TEX` systems, both in `METAFONT` and in Type 1 (PostScript) format. Most likely, also the virtual Euler-VM fonts, the package `eulervm`, and the related documentation are already part of your `TEX` distribution. On CTAN, they are available from the directory `fonts/eulervm/`.

References

- [1] Ronald Graham, Donald Knuth, and Oren Patashnik. *Concrete Mathematics*. Addison-Wesley Publishing Company, Reading, 1989.
- [2] Frank Jensen. The euler package, 1995. CTAN: `macros/latex/contrib/euler/euler.dtx`.
- [3] American Mathematical Society. User’s guide to AMSFonts. CTAN: `fonts/amsfonts/doc/amsfndoc.ps`.

◇ Walter Schmidt
Nürnberger Straße 76
Erlangen
Germany
`w.a.schmidt@gmx.net`
`http://home.vr-web.de/was`