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# The CB Greek fonts

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This paper takes its origin from the documentation accompanying a revision of the CB Greek fonts completed on 1st January 2008, but it goes into deeper detail with comments on many font features that are commonly overlooked. It tells the story of the CB Greek fonts and describes the new features associated with this new distribution.

## 1   Introduction

The CB Greek fonts have been in free use by the TEX community for years now; the bitmapped fonts were available by the end of the '90s, while the scalable Type1 versions started to be available in 2002; some new fonts were added in the following years, but in 2005 a fundamental change was made: the Type1 versions were reduced to the single size of 10 pt, redone completely and associated to a correct encoding vector by Apostolos Syropoulos, who, in a sense, is a co-author of this collection of fonts. I wrote the METAFONT code; he and many other Greek users assisted me in the correction of errors or in a better rendering of specific glyphs.

The whole work had started from the Greek fonts designed by Silvio Levy several years before; they are still available and can be found in the CTAN archives and are being maintained.

When I started working on this project I wanted to create a full set of fonts that could completely match the EC Latin fonts; the latter had been available in the second half of the 1990s, although only in bit map form. The need for Type1 version did exist, but the tools to convert METAFONT fonts into Type1 ones were still rudimentary, in spite of the hard work that many people had spent in creating them. In any case the collection of the CB fonts contained the five families (roman, sanserif, typewriter, slides sanserif, invisible slides sanserif), two series (medium and bold extended) and four shapes (upright, slanted, italics, small caps) that were standard with LATEX at that time. During the creation of the fonts, some requests were set forth, so that an outline

| Size | Result |
|------|--------|
| scaled to 7 pt | αβγδεζηθικλμνξοπρστυφχψως |
| true 7 pt | αβγδεζηθικλμνξοπρστυφχψως |
| true 10 pt | αβγδεζηθικλμνξοπρστυφχψως |
| true 17 pt | αβγδεζηθικλμνξοπρστυφχψως |
| scaled to 17 pt | αβγδεζηθικλμνξοπρστυφχψως |

Table 1: Comparison of some true optical sizes with some shrunk or enlarged fonts obtained from scaling the 10 pt size font.

family was added, the original "italic" shape was enriched with an alternative derived from the types used by the Teubner Typesetting Company of Lipsia; the slanted shape of the two italics was completed with the upright italics, and the small caps were duly completed with the bold versions. Of course also the corresponding fonts for the `slides` class were prepared. Eventually, for typesetting classical Greek philology works, another font was created, mainly for typesetting the metric schematic characteristics of ancient Greek poetry.

The standard sizes for the text EC fonts were 5, 6, 7, 8, 9, 10, 10.95, 12, 14.4, 17.28, 20.74, 24.88, 29.86 and 35.83 points (14 design sizes); while the standard sizes for the slides fonts were 7, 8, 10, 12, 13.82, 16.59, 19.91, 23.89, 28.66, 34.4, 41.28 (11 design sizes) points. Combining all these sizes with the family, series and shape of the various fonts more than 900 driver files were prepared and this distribution contains the corresponding TeX metric files and the Type1 renderings for a total of approximately 2800 files.

The advantage of working with true optical sizes is evident from table 1; shrinking the 10 pt size to 7 pt produces a result that is much smaller, lighter and thinner than the corresponding true 7 pt font; on the opposite, enlarging the 10 pt size to 17 pt produces a result that is larger, darker and heavier than the corresponding true 17 pt font. I won't say that for certain documents, working with a single font to be shrunk or enlarged to the necessity does not produce an acceptable although not optimal result; the sub-optimal result is compensated by a smaller final file, since a smaller number of different fonts gets included in the final PS or PDF file. This is why it is possible to work with the EC and the CB fonts and to invoke the `type1ec` package in order to use just the 10 pt size; this trick does not work with the LM fonts, but this collection uses a smaller overall set of different fonts since it already uses scaling, but only with limited deviations from the unit scale factor.

The Greek encoding for these fonts has always been `LGR`, this name starting with the letter 'L' as an index of being a 'local' temporary encoding; after the first experimental results and the stabilization of these fonts as the default `babel` ones, probably the encoding should have been changed to `T7`; the LaTeX 3 team asked me to modify the layout of these Greek fonts so that the `T7` encoding

would contain the Latin ones in the first 128 positions and the Greek ones in the second half of the 256 glyph table. This request did not take into account the fact that these Greek fonts contain approximately 250 glyphs, and that it was impossible to squeeze 250 glyphs into 128 slots. Well, of course it is possible to change everything and abolish the accented glyphs and reintroduce the accent macros. For the heavy accented *polytoniko* Greek spelling this would be a catastrophe, so I did not fulfill the LaTeX 3 Team request. As an extended encoding, these fonts might be referred to a new X7 encoding; although I proposed it (for no other reason than to avoid the temporary name LGR), my proposal did not receive any answer. I don't believe that the encoding of my fonts is the best possible one; matter of fact I know that I made some general project errors in choosing certain slots for certain glyphs. Nevertheless the whole set works fine and the engineering rule says: "never change what is working fine"; corollary: "Better is the enemy of Good"[1].

The font encoding is not a secondary issue; of course it has to deal with the output of the LaTeX compilation; if the compilation has been done with the assumption of a certain font encoding, an then the real font used is not coherent with that encoding, the output might result completely unreadable, even if the alphabet is the same. A more subtle issue is that hyphenation patterns are specific to a particular encoding. Up to now several Greek hyphenation pattern files have been uploaded to CTAN; I wrote the first, now obsolete file, grhyph.tex; in the past few years three different sets of hyphenation patterns became available, one for modern Greek *monotoniko* spelling, another for modern Greek *polytoniko* spelling, and a third one for classical Greek and its *polytoniko* spelling; they were prepared by Dimitrios Filippou and were: grmhyph4.tex, grphyph4.tex, and grahyh4.tex. All these pattern files rely on the LGR font encoding[2]. On the opposite, the ibhyph.tex Greek pattern file, relies on the Ibycus fonts that have a different encoding and, in particular, use a postfixed diacritical mark notation.

When in 2005 the Type1 fonts were reduced to the 10 pt size only, the CTAN decided to keep the old version of the complete collection; for some reasons this

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[1] In my city, the Municipality decided in the 1930s to build a subway; many good projects were submitted to the Subway Committee, but they were put aside because it was hoped to receive better ones. World War II produced so many ruins that the Municipality had to cope with the reconstruction of the city and the subway problem was set in the background; the first tunnel that had been dug so far was used as an underground car parking. In the 1960s, the subway problem rose again to the attention of the Municipality, and good projects continued to be submitted to the Committee, and regularly they were set aside, hoping for better ones; the 2006 Winter Olympic Games forced the Municipality to take a urgent decision on the matter; eventually, after almost 70 years, we now have the first working stretch of our subway; it is the realization of a good project, not of a better one! This real life story is a practical demonstration that "Better is the enemy of Good".

[2] These files are those distributed with TeX Live 2007; at the moment of writing this paper, new files are being uploaded with version number 5; with these new LGR Greek hyphenation patterns, the author D. Filippou uploads also the patterns to be used with XeTeX and XeLaTeX, and/or with the utf8 package for using Unicode encoded fonts. These new patterns are to be distributed with TeX Live 2008.

statement remained true only for the METAFONT related material, but not for the Type1 fonts.

This redistribution of the full collection of fonts was redone completely from the original METAFONT sources, with no modifications or corrections whatsoever, but the TEX metric files were redone with the latest distribution of METAFONT, and the Type1 fonts were completely redone with modern means, and the encoding vector created by Apostolos Syropoulos was used as the internal encoding of these fonts.

The initial version of the pfb files were obtained very laboriously by Apostolos by means of TeX-trace, the best tool that could be used about ten years ago. Some of the fonts, added in a second time in 2004, were done with a new tool, mftrace by Han-Wen Nienhuys. Years ago also mftrace (at that time called pktrace) resorted to the same tracing algorithm used by TeX-trace, so that the results were absolutely comparable, but the amount of manual work was definitely smaller; nowadays mftrace resorts to a new tracing program, potrace by Peter Selinger; this new algorithm appears to be faster and to produce better outlines, at least to the point that the corresponding pfb files are some 10% smaller than those obtained with TeX-trace. With the previous algorithm and with the actual one, mftrace can resort to the program FontForge by George Williams; this latter program can be used as a batch filter and can perform some postprocessing on the obtained scalable fonts.

The result is that with a proper script for generating the whole set of more than 900 transformations from the METAFONT source to the final pfb files, the total amount of time my laptop spent on this job was some 5 h 45 min of unattended processing, while I was enjoying the 2007 New Year's Eve with my family and friends.

## 2   Customizations

What I added to this new distribution are updated font definition files so that any family, series and shape can be used, even those that are not available with the standard EC fonts. I also added the font definition files that allow using these fonts together with the Latin Modern (LM) ones; since the LM fonts were created explicitly for replacing the EC ones in their Type1 incarnation, I suggest to use always the LM fonts together with the CB fonts; there are some limitations with both sets of Latin fonts, and the details are shown below.

The font description files included with the distribution allow to a certain number of customizations; may be in the future it will be available a LATEX extension file, say, cbgreek.sty, to call with its options from the main LATEX source file of your document, so as to select which "roman" or "italic" or sanserif Greek font you want; you have these choices:

1. between the traditional Didot design αβγδεζηθικλμνξοπρστυφχψως and the Greek fonts with "roman" serifs αβγδεζηθικλμνξοπρστυφχψως;

2. between the imitation of the Olga italics *αβγδεζηθικλμνξοπρστυφχψως* or the Lipsian "italics" *αβγδεζηθικλμνξοπρστυφχψως*;

3. between the standard sans serif **αβγδεζηθικλμνξοπρστυφχψως** and the variant sanserif **αβγδεζηθικλμνξοπρστυφχψως**.

In order to chose the fonts you want to use, you should do the following:

1. If you like the serifed design more than the Didot design, select the `rs` shape for upright characters, and the `ro` shape for the oblique ones.

2. If you prefer the more compact Lipsian font to the Olga one, select the `li` shape; if you are going to use the TX fonts and/or the PX fonts together with the CB ones, you might prefer to use the "slightly darker than normal" series (`b`) instead of the bold extended one (`bx`), so that with fonts different from the EC ones this slightly darker font might be preferable.

3. If you prefer the 'arched' epsilon *ϵ* with sanserif italic fonts instead of the 'curly' one *ε*, select the `iv` shape or the `uv` shape for the oblique or upright sanserif italics respectively.

I did not define any command for using the new shapes, but you would not have any difficulty to add to your preamble these two lines:

```
\newcommand*{\uishape}{\fontshape{ui}\selectfont}
\DeclareTextFontCommand{\textui}{\uishape}
```

so as to be able to use the declaration `\uishape` or the text command `\textui` the same way as you would use the declaration `\itshape` or the text command `\textit`. You can do the same for selecting the other new shapes concerning the serifed fonts, or the Lipsian italics, or the sanserif variants mentioned above; see table 2.

I prepared also the font definition files for using the CB Greek fonts together with the Latin Modern ones. The new shapes are defined in those files; the new commands you defined for your benefit work also when the LM fonts are used for the Latin script. In facts the selection of the Greek alphabet takes place just by changing the font encoding, not the other font characteristics; nevertheless always use high level commands for changing fonts, and never use the real low level family names because the CM/EC family names are different from those pertaining to the LM fonts. In other words do not use `\fontfamily{cmr}\selectfont` for selecting the roman fonts, but use `\rmfamily`, and do the same for the other families. For selecting the outline family use `\outlfamily`; this is not shown in table 2 because, families should not be invoked directly as explained above.

Pay attention to the fact that the LM fonts use some families, series and shapes that are missing from the EC collection, so that if your default series and shape is missing from the CB fonts, sometimes it gets substituted with

| shape | series and shape LaTeX name | Example |
|-------|------------------------------|---------|
| default | md n | αβγδεζηθικλμνξοπρστυφχψως |
| default italics | md it | *αβγδεζηθικλμνξοπρστυφχψως* |
| unslanted italics | md ui | αβγδεζηθικλμνξοπρστυφχψως |
| normal lipsian | md li | *αβγδεζηθικλμνξοπρστυφχψως* |
| slightly darker lipsian | b  li | *αβγδεζηθικλμνξοπρστυφχψως* |
| bold extended lipsian | bx li | ***αβγδεζηθικλμνξοπρστυφχψως*** |
| serifed "roman" | md rs | αβγδεζηθικλμνξοπρστυφχψως |
| oblique serifed "roman" | md ro | *αβγδεζηθικλμνξοπρστυφχψως* |
| sanserif italics | md it | *αβγδεζηθικλμνξοπρστυφχψως* |
| sanserif unslanted italics | md ui | αβγδεζηθικλμνξοπρστυφχψως |
| sanserif variant italics | md iv | *αβγδεζηθικλμνξοπρστυφχψως* |
| sanserif variant unsl. italics | md uv | αβγδεζηθικλμνξοπρστυφχψως |

Table 2: Old and new series and shapes; default series and shapes are not generally shown.

something else, and sometimes it gets substituted with the default font, which might even be the usual roman medium upright font; you get messages in the log file, though. At the same time the LM fonts do not contain certain series and shapes that are present in the CB fonts; therefore the available Greek fonts are used, instead of substituting them as it is done with the Latin ones.

## 3   Special Greek symbols

The CB Greek fonts are completed with several different symbols; some of them are used for the Greek numerals; if you want to use the Acrophonic Attic numerals you have to use the `athnum.sty` package. Otherwise the `greek` option to the `babel` package contains all the commands for generating the required symbols; the package contains also a couple of macros for rendering the common decimal integer numbers into the corresponding Greek numerals written with the common alphabet enriched with the symbols 'stigma', 'qoppa' and 'sampi'; the Greek date can be obtained with the specific commands `\Grtoday`, and today's date is Κϛʹ Ἰουλίου ͵ΒΗʹ, while the usual modern date is typeset by means of `\today` as 26 Ἰουλίου 2008.

## 4   Keyboards

When I made these Greek fonts I had in mind the scholars that have to study and write Greek all over the world; therefore, following Sylvio Levy's example, I kept his Latin-Greek keyboard correspondence, as shown in table 3. I know

that in Greece keyboards are generally set up so as to use both the Latin and
the Greek alphabet. For Greek users using this specific double alphabet layout
there is a simpler way to input the source text file to be typeset; it is possible to
invoke the iso-8859-7.def input encoding file, written by Apostolos Syropoulos,
so as to map the input keyboard codes to the upper half of the Greek keyboard
code page. By so doing the Greek text can be input with the Greek incarnation
of the standard Greek keyboard, while the Latin script requires just the Latin
incarnation of the same keyboard. In this way it is not difficult to write the
source text directly in *monotoniko* Greek, and it's necessary to switch it only
in order to enter the LATEX commands and declarations.

That input encoding file apparently does not help much with the *polytoniko*
spelling; probably in order to use LATEX (and pdflatex) with *polytoniko* spelling
it is better to use the Latin keyboard (see below). It is possible to use the
extended Greek keyboards that use the dead keys[3] but for setting the multitude
of Greek diacritics it is necessary to resort to the Unicode encoding. Generally
speaking this is still in an experimental phase at the level of the TEX community,
because TEX (the program) was not built to cope with double bite character
encodings.

How to solve this problem? Well, it is already solved by Λ, the LATEX in-
carnation of the Ω system designed and continuously improved by Plaice and
Haralambous; but Ω does not use the CB fonts, since it uses those set up for
this program directly by Yannis Haralambous.

Another solution is XƎTEX, and its LATEX incarnation XƎLATEX, the
youngest son of the TEX family[4], who works with Unicode characters without
needing any extension; it can use all kind of Type1, TrueType, and OpenType
fonts, also those not explicitly connected with the TEX system but available
on the computer for use with other programs. Among the fonts usable with
XƎLATEX there is the GFS Didot, freely downloadable from the Greek Font
Society (Εταιρεία Ελληνικών Τυπογραφικών Στοιχείων). I have seen a sample
text composed with XƎTEX and these fonts, and I would say that the result
is excellent. This font contains the Latin and the Greek alphabets with many
Unicode extension pages for a total of 1101 glyphs.

Apostolos Syropoulos is working in the direction of creating new OpentType
fonts that contain both the Latin and the Greek fonts; for the latter he is using
my glyphs and probably he is also using the kerning and ligature information
that is contained in my METAFONT source files, since that information must
be coded in a different way within the OpenType font files. I have seen some
files of this work in progress and I am very happy he is doing it, because the

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[3]On my MacBook Pro OS X I can set up also the extended Greek keyboard; by pressing the
'alt' key and a suitable key on the right of the keyboard I can activate all the 9 combinations
of spirits or diaeresis with the three accents, after which the following vowel comes out on
the screen directly as a single glyph; since my physical keyboard does not have the Greek
glyphs on each key, I have to open the Keyboard Viewer and click on each virtual key with
the mouse and sometimes while pressing the 'alt' or 'shift' keys. It would not be practical for
real input of large amounts of Greek texts!

[4]LuaTEX is still in its gestation; I hope to see it soon.

| α | β | γ | δ | ε | ζ | η | ϑ | ι | κ | λ | μ | ν | ξ | ο | π | ρ | ς | σ | τ | υ | φ | χ | ψ | ω |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | b | g | d | e | z | h | j | i | k | l | m | n | x | o | p | r | s | s | t | u | f | q | y | w |

Table 3: Correspondence between the Latin keys and the Greek letters

Greek community needs a real effective way for typesetting their language also in the polytonic version, without needing to resort to extraneous 'intermediate' characters as the Latin ones. The advantage of using TEX born fonts, as those Apostolos is working on, assures full compatibility of all fonts with one another, math fonts included, so that a well typeset document does not show the patchwork of several more-or-less incompatible designs, styles, shapes, design sizes, stroke weights, . . . that are so evident in many books.

## 5   Usage of the Latin keyboard for typesetting Greek

If you are using some implementation of the Latin keyboard, remember that the Greek letters are obtained by striking the similar Latin keys; 'similar' is either by sound or by shape; just a couple of letters have a Latin counterpart chosen among the available free Latin keys; refer yourself to table 3 for your convenience.

Notice, though, that the final sigma ς comes out by itself, thanks to the font ligature and kerning table; this means that when the Latin 's' is followed by anything different from a letter, which means that the word is finished, the font automatically turns the σ into a ς. This mechanism is so 'sticky' that it becomes difficult to type an isolated σ; in order to do so it is necessary to hide the end of the word to the ligature mechanism, and this is done thanks to a letter-strut; in other words the Latin key 'v' inserts an invisible strut, the height of a lower case letter without ascenders, but with the category code of a letter. So if you type 'sv', the Latin letter 's' is followed by another letter, that does not show on paper or on screen, therefore the 's' is not at the end of a word. At the same time if you are used to type 'c' for inputting the final sigma, you can continue to do so: both `sof'oc` and `sof'os` produce σοφός.

For what concerns the numerous diacritical signs used in Greek, remember that if you do not specify the attribute `polutoniko`[5] to the `greek` language option, you intend to typeset your input with the *monotoniko* spelling, and is up to you to avoid rough and smooth spirits (breathings), graves, and circumflexes, but you should stick to the acute accent and the diaeresis. If you want to write *polytoniko*, you have to specify it with

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[5]**Editor's note:** The reader should note the different spelling between the Greek word πολυτονικό, a noun which means 'with multiple accents' and is commonly transliterated as *polytoniko* with a *y*, and the TEX language attribute `polutoniko`, which is spelled with a 'u' because the letter u corresponds to the Greek lowercase upsilon (υ) in the Greek TEX encoding table established first by Sylvio Levy (Table 3).

| ʾ | ʿ | ¨ | ˜ | ´ | ` | |
|---|---|---|---|---|---|---|
| > | < | " | ~ | ' | ' | \| |

Table 4: Diacritical signs and Latin keystrokes

```
\usepackage[...,greek,...]{babel}
\languageattribute{greek}{polutoniko}
```

With this specification all the signs listed in table 4 can be used for inputting the diacritical signs, even the ˜, that, therefore, can't be used any more as a tie command as in ordinary LaTeX. The diacritical signs are input in any order, but, except the subscribed iota, always before the letter they accompany; `~>a|` and `>~a|` both yield ᾆ; `<rwma"ik'os` yields ῥωμαϊκός.

It's necessary to pay attention to the diaeresis sign; it behaves as a diaeresis only if it is followed by a letter or an accent; it behaves as an apostrophe if it is after the end of a word; the normal apostrophe key is already used for the acute accent. At the same time when spelling *monotoniko* you have to type in `'a"ulos` to obtain άϋλος, but you can type in `>'aulos` in `polutoniko` to get ἄυλος (although modern Greeks, even when spelling `polutoniko`, often use a redundant diaeresis: `>'a"ulos` and get ἄϋλος in order to emphasize the hiatus).

Punctuation marks are the usual ones even if they might appear differently; see table 5. Please notice the apostrophe can be obtained both with the double straight quotes and with two single apostrophe signs; the Greek quotation marks, similar to the French *guillemets*, are obtained with a ligature of two similar parentheses.

| , | . | · | : | ! | ; | – | — | ' | ' | ( | ) | « | » |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| , | . | ; | : | ! | ? | -- | --- | " | '' | ( | ) | (( | )) |

Table 5: Punctuation signs and Latin keystrokes

## 6 Extensions

The package `teubner` greatly extends the facilities offered by the CB Greek fonts; it replaces the italics shape with the Lipsian one, but more evidently defines a myriad of new commands to perform the most unusual operations, such as to put or stack accents on any letter, invoke with explicit commands the accented characters, which helps very much in the quality of kerning; as a matter of fact, the ligature mechanism works only on two consecutive signs and this inhibits proper kerning with letters that came before the ligature was concerned. A postfixed scheme of accents (instead of prefixed ones) would eliminate this 'feature', but it would introduce other ones. At the same time the commands used in `teubner` allow to address directly the specific accented glyphs so that the kerning mechanism can work without problems.

*C. Beccari*

| | '00 | '01 | '02 | '03 | '04 | '05 | '06 | '07 | '10 | '11 | '12 | '13 | '14 | '15 | '16 | '17 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| '000 | − ₀ | ˘ ₁ | ⊠ ₂ | ⊞ ₃ | ⊠ ₄ | Ⓜ ₅ | ϛ ₆ | ϛ ₇ | ι ₈ | A_Ι ₉ | H_Ι ₁₀ | Ω_Ι ₁₁ | A ₁₂ | Υ ₁₃ | α ₁₄ | ϋ ₁₅ | "00 |
| '020 | ، ₁₆ | ، ₁₇ | ᵗι ₁₈ | Ϙ ₁₉ | ⌣ ₂₀ | Ϙ ₂₁ | Ϙ ₂₂ | λ ₂₃ | € ₂₄ | ‰ ₂₅ | ∂ ₂₆ | ⅄ ₂₇ | ' ₂₈ | ' ₂₉ | ˘ ₃₀ | ‾ ₃₁ | "10 |
| '040 | ˜ ₃₂ | ! ₃₃ | ¨ ₃₄ | ⌐ ₃₅ | ⌐ ₃₆ | % ₃₇ | · ₃₈ | ' ₃₉ | ( ₄₀ | ) ₄₁ | * ₄₂ | + ₄₃ | , ₄₄ | - ₄₅ | . ₄₆ | / ₄₇ | "20 |
| '060 | 0 ₄₈ | 1 ₄₉ | 2 ₅₀ | 3 ₅₁ | 4 ₅₂ | 5 ₅₃ | 6 ₅₄ | 7 ₅₅ | 8 ₅₆ | 9 ₅₇ | : ₅₈ | . ₅₉ | ; ₆₀ | = ₆₁ | , ₆₂ | ; ₆₃ | "30 |
| '100 | ˜ ₆₄ | A ₆₅ | B ₆₆ | ^ ₆₇ | Δ ₆₈ | E ₆₉ | Φ ₇₀ | Γ ₇₁ | H ₇₂ | I ₇₃ | Θ ₇₄ | K ₇₅ | Λ ₇₆ | M ₇₇ | N ₇₈ | O ₇₉ | "40 |
| '120 | Π ₈₀ | X ₈₁ | P ₈₂ | Σ ₈₃ | T ₈₄ | Υ ₈₅ | ˝ ₈₆ | Ω ₈₇ | Ξ ₈₈ | Ψ ₈₉ | Z ₉₀ | [ ₉₁ | ˇ ₉₂ | ] ₉₃ | ˝ ₉₄ | ˝ ₉₅ | "50 |
| '140 | ` ₉₆ | α ₉₇ | β ₉₈ | ς ₉₉ | δ ₁₀₀ | ε ₁₀₁ | φ ₁₀₂ | γ ₁₀₃ | η ₁₀₄ | ι ₁₀₅ | ϑ ₁₀₆ | ϰ ₁₀₇ | λ ₁₀₈ | μ ₁₀₉ | ν ₁₁₀ | o ₁₁₁ | "60 |
| '160 | π ₁₁₂ | χ ₁₁₃ | ρ ₁₁₄ | σ ₁₁₅ | τ ₁₁₆ | υ ₁₁₇ | ₁₁₈ | ω ₁₁₉ | ξ ₁₂₀ | ψ ₁₂₁ | ζ ₁₂₂ | « ₁₂₃ | , ₁₂₄ | » ₁₂₅ | ˜ ₁₂₆ | ‒ ₁₂₇ | "70 |
| '200 | ἀ ₁₂₈ | ἁ ₁₂₉ | ἄ ₁₃₀ | ἅ ₁₃₁ | ἂ ₁₃₂ | ἃ ₁₃₃ | ἆ ₁₃₄ | ἇ ₁₃₅ | ά ₁₃₆ | ᾰ ₁₃₇ | ᾰ ₁₃₈ | ᾶ ₁₃₉ | ἀ ₁₄₀ | ἄ ₁₄₁ | ἄ ₁₄₂ | ἆ ₁₄₃ | "80 |
| '220 | ᾶ ₁₄₄ | ᾶ ₁₄₅ | ᾰ ₁₄₆ | Ϝ ₁₄₇ | ᾆ ₁₄₈ | ᾄ ₁₄₉ | ᾆ ₁₅₀ | ˘ ₁₅₁ | ἠ ₁₅₂ | ἡ ₁₅₃ | ἠ ₁₅₄ | ₁₅₅ | ἤ ₁₅₆ | ἢ ₁₅₇ | ἦ ₁₅₈ | ₁₅₉ | "90 |
| '240 | ή ₁₆₀ | ἤ ₁₆₁ | ῆ ₁₆₂ | ἢ ₁₆₃ | ή ₁₆₄ | ῆ ₁₆₅ | ῆ ₁₆₆ | ῆ ₁₆₇ | ῆ ₁₆₈ | ῆ ₁₆₉ | ῆ ₁₇₀ | ῆ ₁₇₁ | ῆ ₁₇₂ | ῆ ₁₇₃ | ῆ ₁₇₄ | ῆ ₁₇₅ | "A0 |
| '260 | ὠ ₁₇₆ | ὡ ₁₇₇ | ὤ ₁₇₈ | ὥ ₁₇₉ | ὢ ₁₈₀ | ὣ ₁₈₁ | ὦ ₁₈₂ | ὧ ₁₈₃ | ὤ ₁₈₄ | ὤ ₁₈₅ | ὢ ₁₈₆ | ὦ ₁₈₇ | ὤ ₁₈₈ | ὤ ₁₈₉ | ὤ ₁₉₀ | ὤ ₁₉₁ | "B0 |
| '300 | ὦ ₁₉₂ | ὦ ₁₉₃ | ὦ ₁₉₄ | Ϝ ₁₉₅ | ὦ ₁₉₆ | ὤ ₁₉₇ | ὦ ₁₉₈ | ₁₉₉ | ι ₂₀₀ | ἱ ₂₀₁ | ἰ ₂₀₂ | ῖ ₂₀₃ | ὐ ₂₀₄ | ὐ ₂₀₅ | ὐ ₂₀₆ | ῦ ₂₀₇ | "C0 |
| '320 | ί ₂₀₈ | ῐ ₂₀₉ | ῐ ₂₁₀ | ῖ ₂₁₁ | ύ ₂₁₂ | ῠ ₂₁₃ | ῠ ₂₁₄ | ῦ ₂₁₅ | ῖ ₂₁₆ | ῖ ₂₁₇ | ῐ ₂₁₈ | Ι ₂₁₉ | ῠ ₂₂₀ | ῠ ₂₂₁ | ῦ ₂₂₂ | Υ ₂₂₃ | "D0 |
| '340 | ὲ ₂₂₄ | έ ₂₂₅ | ὲ ₂₂₆ | ἒ ₂₂₇ | ὸ ₂₂₈ | ό ₂₂₉ | ὸ ₂₃₀ | ὀ ₂₃₁ | έ ₂₃₂ | ἔ ₂₃₃ | ἒ ₂₃₄ | ἒ ₂₃₅ | ό ₂₃₆ | ὄ ₂₃₇ | ὸ ₂₃₈ | ὀ ₂₃₉ | "E0 |
| '360 | ϋ ₂₄₀ | ῒ ₂₄₁ | ῗ ₂₄₂ | ῧ ₂₄₃ | ϋ ₂₄₄ | ὃ ₂₄₅ | ὅ ₂₄₆ | ὕ ₂₄₇ | α ₂₄₈ | η ₂₄₉ | ω ₂₅₀ | ῥ ₂₅₁ | ῤ ₂₅₂ | ₂₅₃ | ' ₂₅₄ | ، ₂₅₅ | "F0 |
| | "00 | "01 | "02 | "03 | "04 | "05 | "06 | "07 | "08 | "09 | "0A | "0B | "0C | "0D | "0E | "0F | |

Font: grmn1000.

ΑΒΓΔΕΖΗΘΙΚΛΜΝΞΟΠΡΣΤΥΦΧΨΩ

αβγδεζηθικλμνξοπρςστυφχψω

Font parameters

| | |
|---|---|
| slant per pt | 0.0pt |
| interword space | 3.33252pt |
| interword stretch | 1.66626pt |
| interword shrink | 1.11084pt |
| x-height | 4.3045pt |
| quad width | 9.99756pt |
| extra space | 1.11084pt |

Table 6: The layout of the textual CB Greek fonts

The documentation of the package is quite ample, considering also the various new environments for setting the rhythmic schemes of classical Greek poetry.

# 7    Known bugs and features

I admit that when I wrote the macros that make the CB Greek fonts usable I believed that I could get along without caring of other packages. This was an evident mistake, and while I keep maintaining the fonts and the teubner package, I try to overcome the incompatibilities that are gradually showing up.

Certainly the clash between the \digamma command of amsmath and friends with the homonymous command of the Greek language, did show itself from the very beginning, when Apostolos did prepare the babel language description file for the Greek language; since the early tests, it was evident it was neces-

sary to define different commands. In fact, for using the lower and upper case digamma signs in Greek, ϝ, F, it is necessary to use respectively the commands `\ddigamma`, and `\Digamma`, none of which clashes with amsmath and friends. The teubner package adds `\f` and `\F`.

The latest teubner package version, uploaded to CTAN after this full collection was uploaded, solves some other clashes that appeared to exist with amsmath and friends. Users are therefore kindly requested to inform me about such clashes and/or clashes with other packages; if possible they should accompany their bug notification with a minimal example and/or, if they discovered the cause, the description of the cause of the clash. Please refer to my new e-mail address:

```
claudio dot beccari at gmail dot it
```

## 8    The fonts

Table 6 shows the layout of the normal text Greek font inspired by the Didot design; most of the glyphs were designed by Silvio Levy, but all of them were revised; in particular the ligature mechanism with the two species of sigmas were completely redone, so as to have many more slots available for accented characters.

Table 7 displays the families series and shapes available with the CB Greek fonts. It's worth noting that all families have some series and/or shapes that are absent from the regular EC fonts. On the opposite there are some series and/or shapes missing from the LM fonts; the latter contain for example the slanted version of the caps and small caps, but, at the moment, they do not contain the bold caps and small caps. The LM fonts contain also some demi bold condensed versions that here are available only for the Lipsian shape.

The user should not worry too much about these inconsistencies, in the sense that if he/she asks for a missing shape or series, the typesetting engine will inform him/her in the log file of what is missing and what has been substituted. In spite of these deficiencies, the user may keep in mind that the EC, LM and CB collections contain more families, series and shapes that most commercial fonts. For what concerns the CB fonts, it is not unlikely that new series and shapes will be designed in the future; for the moment it is necessary to do with what is available now, which is satisfactory for most typesetting works.

## 9    Some remarks

This font collection includes the map file `cbgreek-full.map` for use with those TEX system programs that use scalable fonts; the 1034 METAFONT source files individually labelled as belonging to the CB Greek font collection; the 944 TEX metric files derived from the METAFONT sources; the 944 Type1 font files in pfb format; the font description files that match those of the T1 encoded EC

| | regular | outline | sansserif | typewriter | slides proportional | slides monospaced | metrae |
|---|---|---|---|---|---|---|---|
| upright shape | m, bx | m, bx | m, bx | m | | | m |
| slanted shape | m, bx | m, bx | m, bx | m | | | |
| upright serifed shape | m, bx | | | | | | |
| slanted serifed shape | m, bx | | | | | | |
| italics shape | m, bx | m, bx | m, bx | m | | | |
| Lipsian italic shape | m, b, bx | | | | | | |
| upright italics shape | m, bx | m, bx | m, bx | m | | | |
| italics variant | | | m, bx | | | | |
| upright italics variant | | | m, bx | | | | |
| small caps shape | m, bx | m, bx | m, bx | m | | | |
| visible | | | | | m, bx | m | |
| invisible | | | | | m, bx | m | |

Table 7: Families, series and shapes available with the CB Greek fonts. Each table slot contains the symbols for 'medium', 'bold', and 'bold extended' when they are available for that particular family and shape that label the respective rows and columns.

and LM fonts. Of course the distribution includes the informative `cbgreek.pdf` file and its TeX source, and the font layout file `grmn1000table.pdf` (table 6).

The encoding file CB.enc was prepared by Apostolos Syropoulos for his rendering in pfb format of my METAFONT fonts at the only size of 10 pt. I modified a little the file comments related to some particular CB glyphs or certain specific positions of the CB fonts, but the substance is by Apostolos. The font description files whose names start with `lgrcm` or `lgrlcm` are distributed with `babel` and were originally prepared by Apostolos Syropoulos, before Johannes Braams verified them and included them into his bundle. I modified the `lgrcmr.fd` and `lgrcmss.fd` font description files in order to accommodate the new shapes[6].

The copyright of the source METAFONT files is mine, but without the support of Apostolos Syropoulos I would have done nothing; much of what I put in the source files derives from Apostolos; therefore he shares with me all the rights of the copyright holder.

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[6]By the way, the original `fd` files contain a warning that modifications can be made but the modified files cannot be distributed with the same name. This warning applies to all files distributed with the `babel` bundle; this restriction, though, cannot be applied to the `fd` files, because their name *has to be* built up with the agglutination of the encoding and the family names.

# 10  Acknowledgments

I have to thank many people and I can't list all of them here, but some are so important that I have to specify:

Silvio Levy produced the first Greek font files I started with; if I had to start from scratch my fonts wouldn't even exist.

Yannis Haralambous wrote other METAFONT files after those of Levy; I got suggestions also from Yannis' files. He gave me also very fine advice and suggestions, for which I thank him in a special way.

Jorge Knappen produced the EC fonts from which I got the whole idea of extending that approach to the Greek fonts; for compatibility reasons, therefore, I extracted his METAFONT interpolation routines from his files and put them in the file `cbspline.mf`; the merit of generating fonts of any size between 5pt and 99.99pt comes directly from Jorge.

Apostolos Syropoulos, the president of the Greek TEX Friends (Σύλλογος Ἑλλήνων Φίλων τοῦ TEX), assisted me with patience and countless suggestions, criticism and time spent in testing the various versions of the fonts. He also was the first one who dared using my fonts, and, he told me, he started with the slides for a speech he gave several years ago, when no other Greek TEX fonts were available for slides. He also wrote the experimental versions of the babel extensions for the Greek language and defined the font definition files that go with version 3.7 of babel.

Dimitrios Filippou tested my fonts and sent me a conspicuous number of suggestions and criticism for which I thank him very much. He also "forced" me to produce the Lipsian Greek fonts; he cooperated in this task revising the different glyphs several times; he spent a lot of time helping me with these fonts; without his help the Lipsian fonts would not exist. Later on he helped me with the revision of the sans serif fonts and revised every single lower case glyph in this family. Again a lot of thanks.

Many thanks also to the unknown Greek TEX Friends who, with the intermediation of Apostolos, let me know the bugs of the METAFONT code I wrote, so that I could correct it and possibly eliminate some of those bugs.