New Greek fonts and the `greek` option of the babel package

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Abstract

A new complete set of Greek fonts and their use in connection with the babel `greek` extension is described. Some suggestions are proposed so as to enhance some TEX related utilities and some LATEX 2ε font description macros.

1 Introduction

TUGboat already reported several papers on the possibility of typesetting Greek with (LA)TEX. Perhaps the first paper was the one by Silvio Levy [1] who, so to speak, set forth a standard of fonts and macros in order to set texts both in English (or any other "Latin" written language) and Greek.

His fonts, prepared to be generated with METAFONT v.1.x, were very good replicas of the "standard" Didot Greek fonts; besides digits and punctuation marks, they contained the 24 upper case letters and the 25 lower case ones with all kinds of accents and breaths and implied such ligatures so as to insert the diacritical signs by inputting the corresponding keystrokes before (or after for the iota subscript) the letter to be marked. The correspondence between the keys of a "Latin" keyboard (namely the US keyboard) and the Greek letters and the diacritical signs was established in such a way that everybody, except perhaps Macintosh users who have access to utilities for configuring their keyboards for any "alphabet", got acquainted with Levy's convention in such a way as even people, like Beccari, who are not of Greek mother language, can read Greek compuscript text set on the screen with latin characters just as easily as real Greek text set with true Greek fonts.

Levy's fonts exploited the METAFONT ability to describe fonts with 256 glyphs, but at his time drivers could generally handle only 128 glyph fonts. Haralambous [3] therefore developed a set of Greek fonts with 128 glyphs by reducing Levy's set in such a way as to keep the substantial and most frequent accent vowel ligatures, and to do away with the automatic setting of the initial/medial sigma as opposed to the final sigma.

Mylonas and Witney [5] soon after proposed a set of fonts based on a main 256 glyph font and its adjunct font (a 128 glyph one) by which they could cover the extended necessities of the full set of Greek glyphs, including any sort of breath-accent-vowel-iota subscript combinations, including the *ov* ligature with its diacritics; in this way they implemented each "alphabet" with more than 300 glyphs. Of course, due to TEX limitations, they had to make some compromises for hyphenation of Greek text; as TEXies well know, TEX can hyphenate words composed of glyphs taken from the same font, so that when the adjunct set was called for, TEX was unable to hyphenate.

Haralambous [4] also described the hyphenation of ancient Greek, but for several years no further advances were done in the field of typesetting Greek, because (we suppose) LATEX was undergoing one of its major changes, the transformation into LATEX 2ε with its standard use of the NFSS (New Font Selection Scheme) which has the ability to deal with several font encodings, and the babel package was getting richer and richer thanks to the introduction of the Cork "double" font encoding with 256 glyphs, that tremendously facilitated typesetting all those European and extra European languages that use lots of diacritical signs; moreover Haralambous had started the enormous task of developing Ω, a descendant of TEX that can handle 16 bit Unicode coded fonts.

Also Dryllerakis [6] generated with METAFONT a set of Greek fonts that included the regular, boldface, slanted and italic typefaces; these fonts are to play an important role as we shall see soon.

For Greek it was necessary to wait for the constitution of the Greek Society of TEX Users, in order to have the enthusiasm and the will to sit down and prepare a complete set of babel macros and environments capable of handling the necessary change of font encoding (with the corresponding changes into the catcodes of the various extended ASCII codes) and the switching in and out from Greek or Latin font typesetting.

Syropoulos took the initiative of collaborating with Johannes Braams, the author and curator of babel [10], for writing the `greek` option to the babel package. When Syropoulos first wrote his `greek.ld` language definition file, he made reference to the Dryllerakis fonts, that were the most complete set at that time.

Apparently everything was settled for the Greek authors and for the Ellenists around the world, because they now had all the necessary tools for typesetting Greek texts, both as main ones and as citations within "Latin" written ones.

Beccari, triggered by a teacher of classical Greek in Italian high schools, was induced to get strongly involved in producing a set of tools for his friend; when he had last examined the CTAN archives he had not noticed the `greek` extension to babel nor the Dryllerakis fonts; both had been there for a certain

time, but nevertheless he missed them. He started working on Levy's fonts, but he wanted to generate something that could be just as versatile and complete as Jörge Knappen's ec "Latin" fonts are [7].

When he finally discovered the existence of both the Dryllerakis fonts and the greek babel extension by Syropoulos, he found out that his work, after all, was not a complete waste of time.

In facts Syropoulos could not avoid some short cuts for the lack of optically compatible sans-serif Greek fonts, to the point that the "new" LaTeX 2_ε font changing commands had to refer to other (not by Dryllerakis) Greek font families in order to avoid too many font substitutions.

2 The cb Greek fonts

When Beccari submitted his fonts to Syropoulos, the latter agreed that the cb set was more complete and supported the former with lots of helpful suggestions. Beccari ended up with a set of fonts [8], that he unmodestly called cb Greek fonts (as well as Kostis Dryllerakis' fonts are named after him kd Greek fonts), which is very rich in families, series, and shapes, so that all LaTeX 2_ε font changing commands refer to a specific font, and new commands may be defined in addition to the standard ones. According to Beccari's idea, all the Greek fonts are supposed to be optically compatible with one another *and* with the corresponding "Latin" ones. See the appendix for a sample of mixed text written with several families and shapes.

His work led him to conclude that the NFSS idea of encoding, family, series, and shape are possibly incomplete in order to describe a set of fonts, or at least Beccari's imagination was not wide enough to find a better description of the font characteristics.

Beccari decided that his fonts had to be based on Knappen's algorithm for interpolating the various font parameters, just as Knappen's ec fonts. So he "borrowed" Knappen's interpolating macros; such METAFONT macros work perfectly with the ec fonts; if they work well also with the cb fonts, it is just Knappen's merit, should they behave improperly it is just Beccari's demerit.

Beccari worked on the families, series and shapes listed in Table 1; the boldface series applies to all families except the monospaced ones. The outline family has only the medium and bold extended series. Fonts for slides comprise both proportional and monospaced, visible and invisible varieties, but lack the serifed proportional shapes, as well as it happens for the "Latin" ec fonts.

As Table 1 clearly shows, the cb font set is even wider than the standard ec fonts directly accessible with the standard LaTeX 2_ε font changing commands. Actually the ec fonts include some shapes that require special commands to become usable in a document, or require some modifications to the standard font description files.

Syropoulos' greek.ld language definition file contains all the necessary commands to invoke any of those valid family, series and shape combinations, and the accompanying .fd font description files behave accordingly.

3 METAFONT considerations

It is necessary at this point to underline a drawback of the ec and cb METAFONT source files. METAFONT produces the .tfm and .????gf[1] files whose name derives from the jobname special METAFONT string variable; this jobname is assigned a value equal to the name of the first file input by the specific METAFONT run.

This approach does not produce any inconvenience with the standard cm fonts; with the ec and cb fonts, the name of which includes a numerical part equal to (one hundred times) the design size of the specific font, it is somewhat redundant to have hundreds of small files containing just two or three lines of METAFONT code; in facts they simply specify the design size again and then input a "generic" driver file whose task is exactly that of interpolating the font parameters. Take for example the main file for the roman medium normal ec (Latin) font:

```
% This is ecrm1000.mf in text format ...
if unknown exbase: input exbase fi;
gensize:=10;
generate ecrm
```

After inputting, if necessary, the base file for the ec fonts, the design size is set with a value that actually is already part of the file name (a part a factor of 100), and finally inputs the "generic" file for that family, series and shape.

The cb main files are even simpler; for example the main file for the regular medium normal cb (Greek) font is:

```
input cbgreek;
```

(and the same line is contained in any other cb main file); the trick lies simply in the fact that the file cbgreek generates the design size directly from the jobname and from the same jobname it extracts the "generic" driver file name specific for that family, series and shape.

[1] The ???? part of the file extension may be void, or it is formed by the product of the resolution times the magnification of the used METAFONT mode.

Table 1: The cb Greek font families, series and shapes

Family	Series	Shape
regular	medium	normal
outline	bold extended	oblique
sans serif	monospaced	italic
typewriter	invisible	upright italic
sans serif for slides	bold extended invisible	caps-and-small-caps
typewriter for slides	monospace invisible	

Where is the drawback, then? It consists in the hundreds of small specific main files necessary for generating the `jobname` correctly, instead of working the other way around. This implies that the file system gets overloaded with hundreds of small files, individually smaller than the smallest addressable disk memory unit, that nevertheless clog the disk with unnecessary information.

The excellent trick devised by Knappen of including the design size directly in the file name, so that the `jobname` is assigned the correct value, is sort of hijacked by the rigidity of METAFONT that does not allow to assign a value to `jobname` with an explicit assignment. If one could run METAFONT with a command such as:

```
mf \mode:=ljfive; mag:=1; gensize:=10;
   input ecrm
```

with `ecrm.mf` starting with

```
jobname:=jobname & decimal(100gensize);
```

no specific main files would be necessary allowing for an enormous saving of disk space. In computers with file systems that are not too smart, each main file, although smaller than a block or sector (512 bytes), may reserve up to 16Kb or 32Kb of disk space, and the hundreds of main files necessary to generate the `ec` fonts may take up several megabytes of disk space.

With the `cb` fonts Beccari got used to a simple batch file[2] that generates the specific main file, runs METAFONT, and then deletes the now unnecessary main file[3]:

```
@echo off
if "%1"=="" goto message
if "%2"=="" goto dpi600
if "%2"=="600" goto dpi600
if "%2"=="300" goto dpi300
echo "Density %2 non allowed"
echo "Nothing done           "
echo "======================"
goto endbatch
:dpi300
set dpi=300
set mfmode=cx
goto dpiset
:dpi600
set dpi=600
set mfmode=ljfive
:dpiset
if exist %1.mf del %1.mf
echo input cbgreek; > %1.mf
mf \mode:=%mfmode%; mag:=1; input %1
if errorlevel 1  goto  endbatch
gftopk %1.%dpi%gf
 c:\texmf\fonts\pk\%mfmode%\beccari
   \cbgreek\dpi%dpi%\%1.pk
move %1.tfm
  c:\texmf\fonts\tfm\beccari\cbgreek
rem
del %1.%dpi%gf
del %1.mf
del %1.log
set dpi=
set mfmode=
goto endbatch
:message
echo Font name missing
:endbatch
```

With this strategy Beccari has the advantage that unnecessary files are always immediately deleted and only the `.tfm` and `.pk` files of the fonts effectively employed are kept on disk.

The disadvantage is that the above batch file can not be handled by those utilities that automatically run the generation of `.tfm` and/or `.pk` files with those TEX systems that may call on the fly such programs as `MakeTeXtfm` and/or `MakeTeXpk`[4]. At the same time both `MakeTeXtfm` and `MakeTeXpk` are smart enough to perform more elaborate tasks

[2] *Batch file* refers to DOS and related operating systems; other operating systems may use the terminology of *script* or *command* file.

[3] For typesetting reasons some lines are wrapped to the following line; in other words an indented line should be imagined as a continuation of the preceding one.

[4] Such utilities with the Windows95 or NT based `MikTeX` version 1.10 or later become `maketfm` and `makepk` respectively.

than simply running METAFONT. They could be modified so as to handle both the ec and the cb fonts in a way similar to the above simple batch file.

Since MakeTeXtfm and MakeTeXpk are able to recognize the font group from the name first letter(s), it would be very simple to add the following file to the ec file bundle:

```
% File ecfonts.mf
% General driver file for ec fonts
  if unknown exbase: input exbase fi;
  string f_name, f_size;
  f_name:=substring(0,4) of jobname;
  f_size:=substring(4,8) of jobname;
  scantokens("gensize:="&f_size&"/100");
  scantokens("generate "&f_name);
```

so that substituting ecfonts to cbgreek, the previous batch file and/or the enhanced TEX utilities could directly generate the .tfm and .pk files without the need of overloading the file system with useless files; notice also that since the main driver files are generated on the fly, if you specify in your source LATEX 2ε file something like:

```
\font\myfont=ecrm2600
```

i.e. an ec font with a design size that is *not* included in the standard font description file, on running LATEX the required ecmr2600.tfm is not found, so that the system is forced to shell out in order to generate it; this task may be performed without error messages by the proposed enhanced MakeTeXtfm utility.

This point sets forward another one: the font description files .fd for the ec fonts (and for the moment also for the cb ones) make use of a "name generating" function genb that most LATEX 2ε users are unaware of, because, although it frequently gets to play its role, it always operates behind the scenes. This function generates the external font name when a particular non-preloaded ec font is called for; but because of the way it is used in the font description files, it can generate names only *for the specified sizes*, not for any size, although the ec fonts (as well as the cb fonts) can be generated for any size from 5 pt to 99.99 pt.

Although the ec and the cb fonts are not vector fonts (well, unless their source files are compiled with Mike Vulis' Vmf METAFONT interpreter that comes with VTEX, or unless they are treated with Syropoulos' perl script mf2pt3 [9] for the generation of Type 3 fonts, that scale pretty well), under certain points of view they are not too different from the other vector fonts, in the sense that they may be properly scaled (to be precise, designed to the proper size) to almost any size.

Actually the genb "file name generating function" that is used in the font description files for the ec (and the cb) fonts is powerful enough to accept any font size, not only those that are specified in such files. If the font description file for the T1-cmr family, for example, contained simple lines such as:

```
\DeclareFontShape
  {T1}{cmr}{m}{n}{<-> genb * ecmr}{}
```

a user could specify in his source .tex file:

```
\DeclareFixedFont
  {\myfont}{T1}{cmr}{m}{n}{26}
```

causing the NFSS macros to ask LATEX 2ε to look for the external file ecrm2600.tfm, possibly shelling out in order to run MakeTeXtfm should that file still be missing. Analogous definitions are usable with the cb fonts.

In a similar way the sizes for text, text math, display math, script and sub-subscript, could be declared differently from the standard sequence with geometrical ratio 1.2; why not $\sqrt[4]{2}$ or the square root of the golden section?

The enhancement of the utilities MakeTeXtfm and MakeTeXpk, and of the font description files, as suggested in the preceding paragraphs, would be very handy in the sense that Kappen's extended fonts[5] (besides the new cb Greek fonts) could be treated almost as vector fonts, at least in the range of 5 pt–99.99 pt.

4 babel greek extension

Greek typesetters as well as Ellenists do not have to bother about the way LATEX 2ε handles the encoding of the Greek fonts compared with that of the Latin ones. Font encoding and character catcodes are dealt with by the internal macros invoked by babel's greek extension behind the scenes[6].

Two Greek languages are actually defined: greek and polutonikogreek; they share the same hyphenation pattern set, but they typeset internal Greek words according to the modern "monotonic" (default) accent system, as opposed to the classical "polytonic" one. Actually there is no other difference.

Accents are introduced by means of some ordinary ASCII characters, not by means of control characters as it is the case with Latin alphabets: specifically ' and " are the only ones dealt with by the monotonic system, while with the polytonic

[5] That is, not only the ec fonts, but also the Text Companion fonts that are identified with similar names and generated with the same interpolating macros.

[6] The functionality described here relates to what can be achieved with release 3.7 of the babel package.

one there are also `‘`, `~`, `<`, and `>`, plus the iota subscript `|`. Since these characters are to be treated in a special way, they are catcoded as letters; uppercasing changes them (except the diaeresis) to a dummy invisible character so that they disappear. Prefixed accents, breaths, and diaeresis and postfixed iota subscript interact with the font specifications so as to produce ligatures; those signs that may be prefixed can be specified in any order, that is `>'a` and `'>a` produce the same result; with monotonic spelling `"'i` and `'"i` produce again the same result.

The same ligature mechanism controls the use of final as opposed to initial/medial sigma; if the typesetter is used to type the letter ‘c’ for the final sigma and the letter ‘s’ for the initial/medial one, he can keep doing so, but if he typed always ‘s’ the font characteristics recognize the end of the word and use the proper sigma in the final position; `t'onos` and `t'onoc` in the input file produce the same result in the output file: τόνος.

One simply declares the language selection with the traditional babel command

```
\selectlanguage{greek}
```

and for short citations in “Latin” characters within Greek text it is possible to use `\textlatin{...}` which behaves exactly as any other font changing command; on the opposite a Greek short citation within another language may be inserted by means of `\textgreek{...}`. The corresponding declarations are `\latintext` and `\greektext`.

While in Greek mode, the usual font changing commands, such as `\emph` or `\textbf` or `\sffamily`, perform as they are supposed to do except they operate on the Greek fonts. In addition to the other font changing commands, the new command `\textol{...}` allows typesetting with the outline Greek fonts. Remember though that all these commands obey the grouping rules, so that when a group is closed, the font parameters revert to the values they had before entering that group. If you change size, for example, within the Greek environment, when you close the Greek citation you automatically get to `\normalsize` or whatever size you had before.

The new commands `\greeknumeral{...}` and `\Greeknumeral{...}` allow typesetting a counter value or an explicit number in Greek lowercase or uppercase numerals. With Syropoulos' `athnum.sty` additional package it is possible to set numbers with Athenian numerals whose glyphs are already contained in the `cb` fonts.

With reference to numbers, and therefore to mathematics, it may be worth noticing that Syropoulos wrote also the package `grmath.sty` that allows to “ellenize” all the log-like operator names such as log, sin, cos,... This is intended especially for Greek authors who write school books with a special attention to young people who are not used to the corresponding (standard) Latin names.

Of course `\today`, while in Greek mode, typesets the date with the Greek names for the months, but keeps Arabic numerals for the day and the year. Another command, `\Grtoday`, typesets the Greek date using the Greek numerals for the day and the year.

In the LaTeX 2ε `enumerate` environment the numbering is redefined in such a way as to use Greek numerals for the numbered items. More specifically, the LaTeX 2ε internal commands that translate a number into a lower or upper case letter are redefined in such a way that the number is converted to a Greek numeral expressed by a suitable combination of the 29 Greek numeral symbols; therefore even page numbering, if requested in alphabetic form, turns to Greek numbering while in Greek mode.

Of course before using the `greek` (or the `polutonikogreek`) babel extension, it is necessary to rebuild the format with the inclusion of the Greek hyphenation patterns. The Greek bundle includes also the suitable hyphenation file, but it does not become effective (as for any other language) until the format file is rebuilt. Although the babel package documentation is explicit on this point, most users fail to notice it, or may be they assume that format rebuilding is automatic.

The necessary steps are quite simple; after verifying that one has the babel bundle on the hard disk, it is necessary to locate the file `language.dat`, and edit it so as to append the following lines[7]

```
greek grhyph.tex
=polutonikogreek
```

then run the TeX initializer according to the instructions that come with the TeX system. With `MikTeX` it is very simple, since it suffices to give the line command

```
makefmt latex
```

from a DOS window; with other systems the procedure is very similar although it might be necessary to give more instructions and/or move files from one directory/folder to another.

[7] This might be the right moment for controlling that the loaded hyphenation files correspond exactly to the languages one wants to use; it is convenient to control also that the file names correspond exactly to those one has on the hard disk TeX search path; in case it is possible to fetch the proper files from CTAN.

In order to complete the collection of useful files that complement the basic `greek` option to babel, it is worth noticing that Syropoulos wrote also a number of other files that can be very useful for the Greek typesetters as well as the other Ellenists.

A first file `iso8859-7.def` [11] extends the collection of distributed encoding files so as to map directly the keystrokes of a standard Greek keyboard to the internal `cb` font codes; this allows people to enter their LaTeX Greek text using actual Greek characters, which makes the `greek` option more user friendly.

A second set of files [11] generates either a single `cb` font driver file (a perl script `gendrv`) or the complete sets of both the text and slide fonts driver files (`cbstdedt.tex` and `cblstded.tex` respectively). At the moment these files are precious; should `makeTeXtfm` and friends be enhanced as suggested in this paper, their utility would be confined to those systems that do not allow to shell out.

A third file is `hellas.bst` [12], a bibliography style to be used with BiBTeX for creating mixed bibliographies (Greek and non-Greek) in a "consistent" way.

5 Conclusion

The appendix shows the appearance of several Greek fonts in line with the corresponding Latin ones; of course the different shape of the single glyphs makes it very evident the change between Latin and Greek, but the use of the same font parameters both for the overall alphabet and for the single characteristics of the strokes (fine, crisp, ... lines; vertical and horizontal upper and lover case strokes, upper case serifs, etc.) guarantee that there is some optical compatibility between the corresponding Latin and Greek alphabets. Nevertheless the sans serif family turned out more difficult than expected, so that few font parameters had to be modified.

The italic shape for all families and series was completely redesigned trying to get some inspiration from the elegant italic shape named Olga produced by the Greek Font Society [13]; since Beccari is neither an artist nor a good programmer, the result can not be even compared to the original Olga font, but if the constraints imposed by the "metaness" are taken into account, the results may be considered acceptable.

Criticism and suggestions, of course, are welcome.

References

[1] Levy S.: "Typesetting Greek"; the file `greekhistory.tex` is available from the CTAN archives.

[2] Levy S.: "Using Greek Fonts with TeX", *TUGboat*, 9(1):20–24.

[3] Haralambous Y. and Thull K., "Typesetting Modern Greek with 128 Character Codes", *TUGboat*, 10(3):354–359.

[4] Haralambous Y., "Hyphenation patterns for ancient Greek and Latin", *TUGboat*, 13(4):457–469.

[5] Mylonas C. and Whitney R., "Complete Greek with adjunct fonts", *TUGboat*, 13(1):39–50.

[6] Dryllerakis K.: "The `kd` Greek fonts", available from the CTAN archives.

[7] Knappen J., The `ec` fonts released on 1997/01/17 together with the sixth upgrade of LaTeX 2_ε; the previous (almost definitive) temporary release, called the `dc` fonts, was described in "Release 1.2 of the `dc`-fonts: Improvements to the European letters and first release of text companion symbols", *TUGboat*, 16(4):381–387.

[8] Beccari C.: "The METAFONT source files for the `cb` fonts", available from the CTAN archives in the directory `tex-archive/language/greek/cb/mf`.

[9] Syropoulos A.: `mf2pt3` perl script, available at `http://obelix.ee.duth.gr/~apostolo`.

[10] Beccari C., Braams J., Syropoulos A.: "The `babel` bundle for the Greek language", will be available from the CTAN archives together with the new release 3.7 of `babel`. A preliminary version may be found in `ftp//obelix.ee.duth.gr/pub/TeX`.

[11] Syropoulos A.: `iso8859-7.def`, `gendrv`, `cbstdedt.tex`, and `cblstded.tex` are availabe in the CTAN archives in the directory `tex-archive/language/greek/cb/misc`.

[12] Syropoulos A.: `hellas.bst` is available in the CTAN archives in the directory `tex-archive/language/greek/cb/BiBTeX`.

[13] Matthiopoulos G.D.: "Oblique or Italics? A Greek Typographical Dilemma", in *Greek letters – From Tablets to Pixels*, Makrakis M.S. ed., Oak Knoll Press, New Castle, Delaware, 1996.

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Appendix

This is the beginning of J 1,1-8: «Ἐν ἀρχῇ ἦν ὁ Λόγος, καὶ ὁ Λόγος ἦν πρὸς τὸν Θεόν, καὶ Θεός ἦν ὁ Λόγος. οὗτος ἦν ἐν ἀρχῇ πρὸς Θεόν. πάντα δι' αὐτοῦ ἐγένετο, καὶ χωρὶς αὐτοῦ ἐγένετο οὐδὲ ἓν ὃ γέγονεν. ἐν αὐτῷ ζωὴ ἦν, καὶ ἡ ζωὴ ἦν τὸ φῶς τῶν ἀντρώπων. καὶ τὸ φῶς ἐν τῇ σκοτίᾳ φαίνει, καὶ ἡ σκοτία αὐτὸ οὐ κατέλαβεν.

Ἐγένετο ἄντρωπος ἀπεσταλμένος παρὰ Θεοῦ, ὄνομα αὐτῷ Ἰωάννης· οὗτος ἦλθεν εἰς μαρτυρίαν, ἵνα μαρτυρήσῃ περὶ τοῦ φωτός, ἵνα πάντες πιστεύσωσιν δι' αὐτοῦ. οὐκ ἦν ἐκεῖνος τὸ φῶς, ἀλλ' ἵνα μαρτυρήσῃ περὶ τοῦ φωτός.»

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Date: 12 Ἰουνίου 1998 Greek date: ιβ΄ Ἰουνίου ͵αϡιη΄

Athenian numerals: 1998 = Χ𐅄ΗΗΗΗ𐅅ΔΔΔΔΠΙΙΙ