Computer Modern fonts: Results of a comparison of their Type 1 implementations

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Abstract

A comparison of glyphs (graphic representations of characters) of the Computer Modern public PostScript fonts in the Adobe Type 1 format has been performed. For analysing and comparing glyphs is applied a method of constructing derived fonts. These associated Type 1 fonts visualize node and control points of contour curves and hinting data.

Proof outputs in PDF created with pdfLaTeX that contain glyph images, point and hinting information for a single font or coincidence tests using technique of overlaying corresponding graphic objects with two or more relevant fonts ('clones' of CM) are then overlooked and analysed by Acrobat Reader. For processing and transforming the font files free tools, `t1utils` and `awk`, were also employed.

This article presents selected secondary results of a consequent visual analysis and 'manual' postprocessing of differences between the BlueSky and BaKoMa public Type 1 implementations of the Computer Modern fonts.

1 Introduction

A new (for me, maybe not for a reader) method for generating derived Type 1 fonts [2], its use, an approach of preparing proofsheets with their subsequent analysis and comparison of glyphs of Type 1 fonts was presented by me [1] at the EuroBachoTeX 2002 meeting held since 29 April until 3 May 2002 in Bachotek, Poland.

A new information (previously unknown to the author) about irregular behaviour of glyph outlines of numerous characters in the Type 1 Computer Modern font public implementations, the BlueSky [3] and BaKoMa [4], is presented here. These results also true for other collections developed as extensions from the BlueSky and BaKoMa, e.g. the PL fonts or the CS fonts.

In most cases these detailed 'studies' of glyphs of the Type 1 font characters describe features of approximation and probably have no significant importance for 'real life' typesetting in small printer resolutions. But the resolution of the RIP output devices will be increasing in future. And therefore for rendering on high resolution output devices and printing in larger font magnifications a influence of font irregularities might occur.

Fonts in the Type 1 format are comparable on the node, control point and hint level. The Type 1 coordinates reach only integer values between −2000 and +2000 [2]. The Type 1 fonts usually do not use the `div` command (rendering would be slow and not effective). Therefore nodes, control points and hints have only integer values and their comparison can be exact. METAFONT fonts are a different kind of integer approximation of glyph images and points on the boundary for precise comparison with the Type 1 are not available. The METAPOST output generated form METAFONT sources contains a set of contours defined by closed curve paths and they also can not describe the result of final rasterization more precisely. I do not have tools for a direct comparison between Type 1 and METAFONT.

The METAPOST output in the PostScript does not give us a good possibility for exact comparison between original METAFONT and a corresponding Type 1 implementation. The set of nodes defining PostScript curves of these components do not correspond to points of the final envelope of glyph.

Cases of shape differences between two collections may be divided into categories

bump: a node is situated ouside a imaginary corridor between two neighbouring nodes and makes optical deflection

step: two relative long curves do not join together in one point, but two near node points are connected by a perpendicular (or with similar direction) short line

straight line vs. Bézier curve

different solution of tangency

2 Naming conventions

BlueSky denotes the font collection produced by BlueSky Research and Y&Y, since 1997 distributed under the American Mathematical Society copyright. Version numbers will be later in parentheses and were copied from the corresponding `.pfb` files — 1.0: Aug 1991, 1.00B: Feb–Apr 1992, 1.00: Jul 1992, 001.000: Oct 1992, and 1.100 or 001.100: Jul–Aug 1996.

BaKoMa denotes the font collection produced by Basil K. Malyshev, all the CM files have the version T1FMT-V2.0 with the date 1.1/12-Nov-94.

3 Overview of differences

Glyphs of the BlueSky fonts in the following pictures are lighter and the BaKoMa are darker. Parts of glyphs with significant differences are clipped and zoomed.

3.1 Ligatures ‘fi’ and ‘ffi’

`cmr10`: BlueSky (1.00B) small bump; BaKoMa looks O.K.

`cmr10`: BlueSky (1.00B) tiny bump; BaKoMa O.K.

`cmr6`: BlueSky (1.0) small bump; BaKoMa O.K.

`cmr7`: BlueSky (1.0) bump; BaKoMa O.K.

BlueSky ‘fi’ and ‘ffi’ have similar bumps also in the following fonts: `cmr8`, `cmr9`, `cmr12`.

`cmbx10`: BlueSky (1.00B) step; BaKoMa step

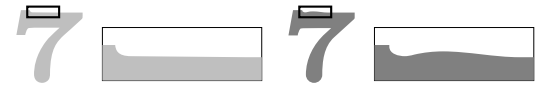
`cmbx10`: BlueSky (1.00B) step; BaKoMa step

`cmbx8`: BlueSky (1.0) step; BaKoMa step

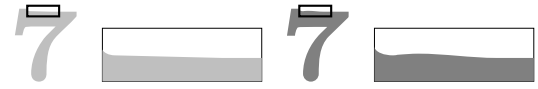
The BlueSky ‘fi’ and ‘ffi’ have similar steps also in the following fonts: `cmbx5`, `cmbx6`, `cmbx7`, `cmbx9`, `cmbx12`, `cmbxsl10`; the BaKoMa in `cmbx5`, `cmbx7`, `cmbx9`, `cmbx12`, `cmbxsl10` (not in `cmbx6`).

`cmsl10`: BlueSky (1.0) bump; BaKoMa

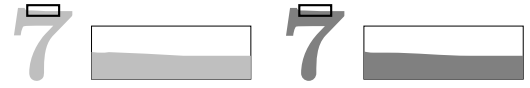
3.2 Digit ‘7’



`cmbx5`: BlueSky (1.0) O.K.; BaKoMa bump



`cmbx6`: BlueSky (1.0) O.K.; BaKoMa small bump

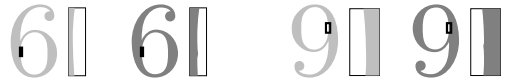


`cmbx7`: BlueSky (1.0) tiny bump; BaKoMa tiny bump

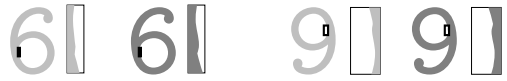
`cmbx8`: BlueSky (1.0) tiny bump; BaKoMa tiny bump and strange beak

3.3 Digits ‘6’ and ’9’

`cmr10`: BlueSky (1.00B) O.K.; BaKoMa small bump



`cmcsc10`: BlueSky (1.0) O.K.; BaKoMa tiny bump



`cmtcsc10`: BlueSky (1.0) small bump; BaKoMa small bump

`cmsl10`: BlueSky (1.0) O.K.; BaKoMa tiny bump

`cmsltt10`: BlueSky (1.0) tiny bump; BaKoMa tiny bump

`cmss10`: BlueSky (1.0) O.K.; BaKoMa tiny step

`cmssi10`: BlueSky (1.0) O.K.; BaKoMa tiny step

`cmssq8`: BlueSky (1.0) tiny bump; BaKoMa tiny bump

`cmssqi8`: BlueSky (1.0) tiny bump; BaKoMa tiny bump

`cmtt10`: BlueSky (1.00B) tiny bump; BaKoMa tiny bump

cmitt10: BlueSky (1.0) '6' looks O.K., '9' tiny bump; BaKoMa tiny bump

cmmi10: BlueSky (1.100) O.K.; BaKoMa very tiny bump

cmmib10: BlueSky (1.100) O.K.; BaKoMa '6' very tiny bump, '9' looks O.K.

cmu10: BlueSky (1.0) O.K.; BaKoMa '6' very tiny bump, '9' looks O.K.

cmvtt10: BlueSky (1.0) tiny bump; BaKoMa tiny bump

3.4 Lowercase letter 'g'

cmtt10: BlueSky (1.00B) tiny bump; BaKoMa small bump

cmvtt10: BlueSky (1.00B) tiny bump; BaKoMa small bump

3.5 Ligatures 'fl' and 'ffl'

cmu10: BlueSky (1.0) vs. BaKoMa: different solutions of tangency

cmvtt10: BlueSky (1.00B) step; BaKoMa straight line

Similar effects may be observed in 'ffl'.

3.6 Arrows

Arrows and caligraphic symbols have not been updated in the BlueSky public collection according to the last changes of the METAFONT sources in the cmsy and cmbsy fonts. Only few examples of the comparison of arrows will be shown here.

cmr5: BlueSky (1.00B) vs. BaKoMa: different shapes

cmsy10: BlueSky (1.0) vs. BaKoMa: different shapes

cmbsy10: BlueSky (1.00) vs. BaKoMa: different shapes

3.7 Caligraphic symbols

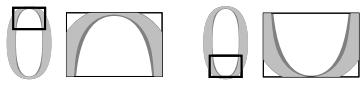
cmsy10: BlueSky (1.0) vs. BaKoMa: different shapes

cmsy10: BlueSky (1.0) vs. BaKoMa: different shapes

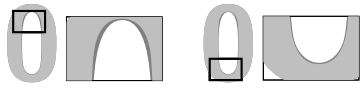
cmbsy10: BlueSky (1.00) vs. BaKoMa: different shapes

cmbsy10: BlueSky (1.00) vs. BaKoMa: different shapes

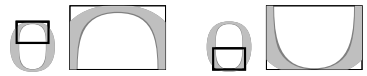
3.8 Digit '0'



cmr10: BlueSky (1.00B) vs. BaKoMa: dif. width

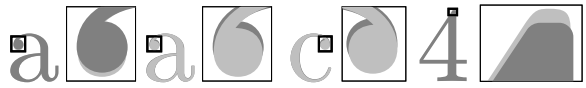


cmssbx10: BlueSky (1.0) vs. BaKoMa: dif. width



`cmmi10`: BlueSky (1.100) vs. BaKoMa: dif. width

3.9 Lowercase letters 'a', 'c', 'm'



`cmr10`: BlueSky (1.00B) vs. BaKoMa: different bulb sizes

`cmsl10`: BlueSky (1.0) vs. BaKoMa: different bulbs, BlueSky's '4' is taller

`cmtt10`: BlueSky (1.00B) vs. BaKoMa: different widths

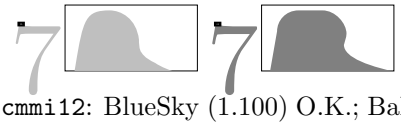
`cmsltt10`: BlueSky (1.0) vs. BaKoMa: different widths

3.10 Other differences

`cmitt10`: BlueSky (1.00B); BaKoMa: probably bad run of path

`cmitt10`: BlueSky (1.00B); BaKoMA bad shape

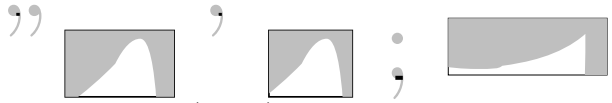
`cmmi10`: BlueSky (1.100) O.K.; BaKoMa tiny bump



`cmmi12`: BlueSky (1.100) O.K.; BaKoMa tiny bump

`cmr6`: BlueSky (1.0) arc; BaKoMa O.K.

`cmr7`: BlueSky (1.0) arc; BaKoMa O.K.



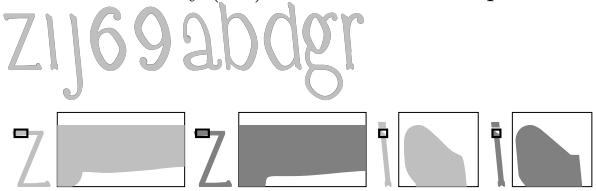
`cmr10`: BlueSky (1.00B) curves are not smooth

3.11 Funny fonts

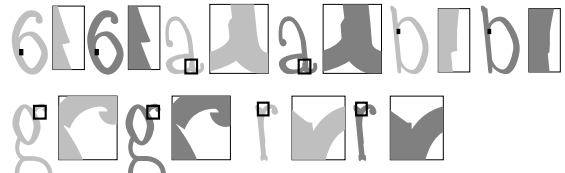
The fonts `cmff` and `cmfi` may be considered not to important. We could here only illustrate few differences between shapes in the BlueSky and BaKoMa and several representatives of irregularities where both implementations are very similar.

`cmff10`: BlueSky (1.0) vs. BaKoMa: diff. shapes

`cmff10`: BlueSky (1.0) vs. BaKoMa: bumps in arms



`cmff10`: BlueSky (1.0) vs. BaKoMa



`cmff10`: BlueSky (1.0) vs. BaKoMa: irregularities

`cmfi10`: BlueSky (1.0) vs. BaKoMa

4 Conclusion

I do not use any font editor. I saw PFAedit at the EuroTEX meeting on May 2 for the first time. But I am sure that everybody who had font editors or other similar tools can repeat and verify my observations and check appropriate characters. It is *only* necessary to known exactly which part of the analyzed glyph should be zoomed. Most of the effects are tiny. For example, if a step or a bump is 3 units in the Type 1 character coordinate system it corresponds to 1 pixel for the resolution 300 dpi and the 72pt font (600dpi/36pt or 1200dpi/18pt respectively). That means any influence could occur only for high resolutions and large font magnifications.

And the results of comparison and analysis demonstrate the difficulty of conversion from the METAFONT sources into the Type 1 format.

References

[1] Karel Píška, A comparison of public CM/EC fonts in Type 1 format, *Proceedings of the XIII European TEX Conference*, April 29—May 3, 2002; Bachotek, Poland.

[2] Adobe Type 1 Font Format.

[3] `CTAN/fonts/cm/ps-type1/bluesky`

[4] `CTAN/fonts/cm/ps-type1/bakoma`