COMPUTED TYPE DESIGN

KEEP AHEAD OF THE CROWD

Christoph Knoth
A Abstract

A lot of tasks in font design are interlinked and a change on one letter will maybe create hours of work on others. The idea of a parametrical typeface could minimize those problems and would allow to design an infinite number of typefaces at the same time.

I will try to understand why this way of designing a font never got widely adopted. If it is possible to create a more easy to use program to design western characters. And finally if this approach to type design would help to create new and interesting curves and shapes for letterforms.

B Introduction

Type design is a long and tedious process. Just to design the basic letters takes days and it sometimes takes years for a full character set. The process has changed over time with technology evolving giving the designer more and more possibilities, at the same time making everything far more complex and complicated. As a result of this only a small group of people are able to design what is nowadays seen as a proper typeface. Besides the broad knowledge that is needed to design a font the learning curve for a novice can be quite long, even with the help of scripting which can do a lot of tasks that normally would have to be done by hand.

In the 70s Donald Knuth developed Metafont. A program that worked with the idea of parametrical fonts and would allow to design an infinite number of typefaces. But why this way of designing never adopted by more then a handful of people?

C History

To understand how type design works today one has to understand the history of type design. That is why I have collected some early historical samples that show first approaches for a mathematical notation and a systematical modification and variation of fonts in a pre computer era.

Followed by a short chapter about the curve and another chapter where I will try to shed some light on the changes that the computer brought to the type design industry.
Some Historical Samples

A collection of 12 constructed “A”s dating from 1460 to 1529.¹

Le Roman de Roi, a font that was drawn for Louis the XIV, is considered as one of the most detailed and exact notations for the mathematical construction of a font.¹

¹ Even though research conducted by Ian Party has shown that there is quite a difference between this idea and the final typeface. But this has more to do with the limited mathematical possibilities at this time than the inability to create a “good” font.
Oswald Coopers Experiment “15 Serifs” shows an early idea for a modular typeface.  

The “Plaque Découpée Universelle” a modular stencil device, from around 1879.

“Falcon stencils” and “Letters built up from the above elements”
• On the right the “cardboard template for making pencil-outline pattern drawings”.

1 Department of Printing and Graphic Arts in the Harvard College Library Cambridge
In mathematics, a curve (sometimes also called a curved line) is, generally speaking, an object similar to a line but which is not required to be straight. This entails that a line is a special case of curve, namely a curve with null curvature.\(^1\) And now we have gone in a full circle and are not much smarter then before, even though this is the best definition I found. And the search for it was very interesting but will probably not help type designers to produce better fonts.

- More interesting is that defining a curve as a geometric object in the time before computers was also a nontrivial task. It was needed to fixate a sketch for the planks of a boat or the wing of a plane. Where you needed to achieve a certain kind of accuracy if you wanted to do a second curve of the same kind. A common procedure to “write down” a curve was to define points that would be on the curve and then fixate them with nails and framing squares. Afterwards thin wooden strips (called “splines”) would be placed in between the nails in a way that the inner force of the spline would create the desired curve.

- Today we are using a series of Bézier curves (more on page 15) where the last point of one curve coincides with the starting point of the next curve and call them “a Bézier spline”.\(^2\) “In computer graphics splines are popular curves because of the simplicity of their construction, their ease and accuracy of evaluation, and their capacity to approximate complex shapes through curve fitting and interactive curve design.”\(^3\) Even though the concept of off-curve points are harder to understand then the old “nails on-curve concept”. But perhaps Spiro curves (page 22) will be one day a usable alternative.

\(^2\) Compare with [http://en.wikipedia.org/wiki/B%C3%A9zier_spline](http://en.wikipedia.org/wiki/B%C3%A9zier_spline)
A Boeing draftman splining a curve and his tools on the right.
It is true, the development of type design has been heavily influenced by printing technology. Until at one point type became more and more independent from material matter. The time when letters could be easily stored, manipulated and arranged inside a computer, changed not only the world of graphic design, but it more or less changed the way how everybody communicates, works and creates. And it did not only change the visual image of the world but also its all driving structure.

- Because the output that shapes this new time is still dependent on the limitations of the technology, recapitulating the development from the very early computer graphics to the rise of global collaborative font design will reveal the strong and weak ideas of digital type design and may help to find new ideas to change it again. That is what the first chapter is for.

1. Peter Bilak in http://www.typotheque.com/articles/in_search_of_a_comprehensive_type_design_theory “The development of type has always been inextricably connected to the development of printing technology.”

1949

Whirlwind went operational in 1949. It was the first digital computer capable of displaying real time text and graphics on a video terminal, which was an oscilloscope screen.

The EDSAC memory display was the first to use cathode ray tubes to display information. The center display shows the contents of the memory.

1946

Freddie Williams and Tom Kilburn developed a cathode ray tube (CRT) that could electronically store binary data. At the same time the tubes “monitor” functioned as a visual representation of the memory.

1947

The picture above is taken from Kilburn’s report to Telecommunications Research Establishment (TRE) Malvern, of December 1947. And can probably be seen as the first electronical generated digital and rasterized type on a screen.

3. http://www.webbox.org/cgi/_timeline50s.html
1952

A handmade prototype of a “light gun” as part of the Whirlwind Project at MIT. It was one of the first electro- nal input devices and was used to change the state of the memory.

1957

The picture shows one of the first digitally scanned letters displayed on an oscilloscope. It was fed into a computer with a rotating drum scanner at the National Bureau of Standards.

1959

Paul de Casteljau developed what was later known as Bézier curves using de Casteljau’s algorithm. The ideas there are based on were widely publicized in 1962 by the French engineer Pierre Bézier, who used them to design automobile bodies. They were a primer part for the later to come postscript language.

1960


1962–1963

Sketchpad is a computer program written by Ivan Sutherland. It was the first program ever to utilize a complete graphical user interface.

- The program used line art that was displayed on a CRT and not a pixelated screen as we know it today. The reason for this has nothing to do with its progressiveness, the reason has much more to do with the lack of memory for a buffer to store all the pixels that would be needed.

Because all the graphics were made up of line art they could also be outputted by a plotter that could draw straight lines and circles.

- When Ivan Edward Sutherland was asked: “How could you possibly have done the first interactive graphics program, the first non-procedural programming language, the first object oriented software system, all in one year?” He replied: “Well, I didn’t know it was hard.”

5 http://www.webbox.org/cgi/1957%20First%20image-processed%20photo.html – article from paper:

6 http://en.wikipedia.org/wiki/B%C3%A9zier_curve

1964

The IBM 2250 Graphics Display Unit was announced […]. Similar to the start screen of sketchpad that reads “INK”. Characters were built of line segments specified by display list subroutines. Thus any character set or font could be displayed, although fonts were generally extremely simplified for performance reasons. The computer altered the display by changing the display list. As the display list got longer, the refresh time got longer too and eventually the display would start to flicker.9

1965

Hell’s 50T1 Digiset, the first digital typesetter, was made commercially available.
- “The process of digitizing the letters happened in an early state of development in photo typesetting. The first fully digitized typesetting system has been the “Digiset”, invented by Hell in Kiel, Germany. The system was presented in 1965. For the first time, a letter has been built up upon little spots. The available fonts were quite rough in resolution and were stored as bitmaps, not as Bézier curves or vectors. Every letter was activated point by point from out of the memory and put together to the whole black and white page containing pictures too.
- A mnemotechnical code was used to build up the page, somewhat similar to HTML. For example, a command like “dz12” was used to set the leading between lines, “sg9” meant a point size of 9. With this method, complete newspaper pages were generated, processed in the mainframe computer and after that send to the output device.”10

1967

In their paper Three Fonts of Computer-drawn Letters M. V. Mathews, Carol Lochbaum, and Judith A. Moss describe three groups of letters drawn with a vector display on a cathode ray tube. It is probably the first serious attempt to draw outlines of letters.11

1968

DigiGrotesk was one of the first commercially available digital fonts and was designed in seven weights from light to bold by the Hell Design Studio.14

---

10 http://www.global-type.org/Digiset.721.0.html
11 Letterform Design Systems by Lynn Ruggles, Page 5
12 Letterform Design Systems by Lynn Ruggles, Page 6
13 Letterform Design Systems by Lynn Ruggles, Page 7
14 http://www.designhistory.org/Digital_Revolution.html
October 1977

A. A. Beers from the Academy of Science in the Soviet Union wrote a program that could read a bitmap character and generate an outline contour using straight and diagonal lines and four different kinds of curves.10

1977–1979

Donald Knuth developed his first version of his layout engine TeX together with the font design engine Metafont (reworked in 1984). It is a scripting based system for desktop publishing and font creation. It has a pen and an outlined model (page 26). Could the interpreter back then only output bitmap fonts it is now also possible to use Metatype1 and produce PostScript fonts.

• All those programs and most of the fonts created with them are available under a free software licence.

mid 1980s

Fontastic (a bitmap font editor by Altsys)

Plotr by Petr van Blokland used the URW Ikarus algorithm. It was the starting point for the later program Pika that would run on MacOS.20

• It later got sold to URW and was the foundation for MacIKARUS (Ikarus M) and later FontMaster.

1981

Bitstream was founded by Mike Parker, the head of Mergenthaler’s font design activity, that had left ITC taking with him three colleagues including the type designer Matthew Carter his former Linotype colleague.21

They are the first to call themselves a digital type foundry. “Through Bitstream, Carter and Parker proposed to license digital typeface designs to typesetting equipment manufacturers, a revolutionary step in detaching the activity of designing digital fonts from that of building the machines upon which to set those fonts.”22

1978

IKARUS from URW in Hamburg introduced at the ATypI in Warsaw. At the beginning it was primarily used to digitize analog letters and not so much for actually drawing type itself. To do that a digitizer tablet and a puck was used to mark a point on all the curves at around every 30°. Further adjustments to every letter could then be made on a screen. One advantage of Ikarus was that it could save lots of letters in a big database.

Ikarus later supported interpolation, and could create a rounded and shaded version of a typeface. It was used for the digitalization of letters in a bigger scale.16

At the end of the same year Linotype stopped to produce metal type setters.17

1975

IKARUS from URW in Hamburg programmed by Peter Karow was introduced at the ATypI in Warsaw. At the beginning it was primarily used to digitize analog letters and not so much for actually drawing type itself. To do that a digitizer tablet and a puck was used to mark a point on all the curves at around every 30°. Further adjustments to every letter could then be made on a screen. One advantage of Ikarus was that it could save lots of letters in a big database.

Ikarus later supported interpolation, and could create a rounded and shaded version of a typeface. It was used for the digitalization of letters in a bigger scale.16

At the end of the same year Linotype stopped to produce metal type setters.17

1975

CSD (Character Simulated Design) was the Ph. D. dissertation of Phillippe Coueignoux. He derived primitives such as stems, arms, and noses and defined the spatial relationships between them. From the evaluation of these primitives, he generated a grammar to describe the implicit structure of the characters in a font.15

Franklin C. Crow developed one of the first practical solutions for the anti-aliasing problem.18

15 Letterform Design Systems by Lynn Ruggles. Page 7
16 Picture and information from the talk: Re-Inventing Technology, Peter Rosenfeld, DTL FontMaster Conference, The Hague, November 2009
18 compare with http://en.wikipedia.org/wiki/Franklin_C._Crow
19 Letterform Design Systems by Lynn Ruggles. Page 6
20 http://www.petr.net/index2/-/p-332
21 compare with Emily King, New Faces – Type design in the first decade of device-independent digital typesetting (1987-1997), PhD Thesis (Chapter One: Technological and Industrial Change: Setting the Scene)
1982
Adobe was founded in December 1982 and develops and publishes PostScript (PS) (a page description language) in the end of the 1983. A picture and line art description language that is still used today. It can be seen as the start of "the age of device-independent digital typesetting technology."

- PostScript was the first software which allowed fonts to be designed and distributed independently of the manufacture of the systems on which they were to be printed. Pages of type described in the PostScript language could be printed on any output device equipped that understand the language.
- To store fonts Adobe used the Type 1 format. It was a simplification of the PostScript system and was not a complete language. That is why it could only store outlines and font information like names and spacing (kerning was stored in a PFM (Printer Font Metrics) file). Adobe would then sell licenses for the Type 1 fonts technology and also offer Type 3 fonts, as a lower-cost implementation of Type 1, which had no hinting support.
- This new storage format and the software to read it lead to many changes in the world of graphic design. It made it very easy to copy typefaces, there was an enormous increase in quantity of typefaces and an "anglicization of type culture" could be observed.

1983
Telefont from Linotype allows the transfer of digital typefaces via the telephone line.

1984
The first Macintosh was introduced on January 24, 1984; it was the first commercially successful personal computer to feature a mouse and a graphical user interface rather than a command-line interface.

1985
Apple introduces LaserWriter a laser printer with built-in PostScript interpreter. It had four typefaces or respectively nine font masters already built in (Adobes adapted versions of Times (Italic, Medium, Bold, Bold-Italic) Helvetica (Medium, Fat) Courier (Medium, Fat) Symbol (Medium)).
- And finally the industrialization, which was criticized by the private press movement, made the private press possible.
- "The Apple LaserWriter was a relatively low resolution printer, 300-dot-per-inch, but provided a lot more graphic and typesetting flexibility than similar machines that were on the market, for example the Hewlett Packard's LaserJet."

In July 1985 PageMaker was introduced by Aldus Corporation. It was one of the first desktop publishing programs, initially for PCs running the then new Windows 0.33 34

Also in 1985 Benjamin Bauermeister developed the "PANOSE System. "It is a method for classifying typefaces solely on their visual characteristics. It can be used to identify an unknown font from a sample image or to match a known font to its closest visual neighbor from a font pool. The word PANOSE is compound from letters taken from the six classes in which the creator of the system organized the Latin alphabet. (read more about it in the text "characterizing typefaces" on page 32).

late 1985
Adobe began to sell fonts independently of output devices. Marking the beginning of the access to device-independent typesetting technologies.36
1986

IBM invents subpixel rendering. It is an improvement of the rasterization and therefore the display quality of type on the screen.

When Altsys released Fontographer\(^{37}\) it was the first successful program in the age of the device-independent type design technologies and lead to a “severe erosion and lose of the coherent professional body that lay behind type design” and a “trend toward independent small-scale activity”.\(^{38}\) Because the “design and distribution of type had been liberated from the large-scale manufacture of typesetting systems” which lost more and more of their control and market.

• “The type designer does not depend on technicians anymore” involving proofs and corrections of those proofs which increased the speed of type design.\(^{39}\) More and more novices\(^{40}\) get access to the type design world. Resulting in more custom typefaces for every kind of purpose.

• At the same time we see a lot of “new” fonts that are just renamed copies with no or little changes in the design.

1988

FontShop was founded by Erik Spiekermann. Later, when the typefoundry Berthold went out of business FontShop overtook their font library.\(^{41}\)

late 1988 and early 1989

Rob Friedman, president of Bitstream, announced that his company had cracked Adobe’s encryption. PostScript printers would now accept and process Bitstream fonts as if they were Type 1 fonts. This finally allowed anyone with the necessary tools to create Type 1 fonts and Adobe lost controls as the only manufacturers of output devices.

• In October 1989, Adobe opened the PostScript page description language and ended the “font war”.

1989–1990

1989 and 1991 are remembered as the “glory years”, “when type revenue was going through the roof.”\(^{42}\)

1990

The first “random” typeface\(^{43}\), called Beowolf was created by Just van Rossum and Erik van Blokland. The letter shapes changed during printing.\(^{44}\) “Beowolf was also the first font in the digital font library FontFont.”\(^{45}\)

1991?

ElseWare developed Infinifont a parametrical font constructor, whose actual main goal was not to ease font design but to save disk space. To achieve this the program used an internal font structure that would create a font according to a given Panose code. After which each glyph had to be worked with the writing of “cryptic” lines of code to further “bend” the shapes to match the desired font.\(^{46}\) At the end of this process only those lines had to be saved resulting in a much smaller font file.

1988

1989 and 1991 are remembered as the “glory years”, “when type revenue was going through the roof.”\(^{42}\)

1990

The first “random” typeface, called Beowolf was created by Just van Rossum and Erik van Blokland. The letter shapes changed during printing. Beowolf was also the first font in the digital font library FontFont.\(^{45}\)

1991?

ElseWare developed Infinifont a parametrical font constructor, whose actual main goal was not to ease font design but to save disk space. To achieve this the program used an internal font structure that would create a font according to a given Panose code. After which each glyph had to be worked with the writing of “cryptic” lines of code to further “bend” the shapes to match the desired font. At the end of this process only those lines had to be saved resulting in a much smaller font file.

May 1991

“The cost of the licensing was considered very high at this time, and Adobe continued to stonewall on more attractive rates. It was this issue that led Apple to design their own system, TrueType, around 1991. [TrueType was released with the launch of Mac OS System 7 in May 1991 and later in March 1992 in Windows 3.1.] Immediately following the announcement of TrueType, Adobe published the specification for Type 1 font format. Retail tools such as Altsys Fontographer (on January 1995 acquired by Macromedia, owned by FontLab since May 2005) added the ability to create Type 1 fonts. Since then, many free Type 1 fonts have been released; for instance, many of the fonts used with the TeX typesetting system are available in this format.”\(^{47}\)

1992
Apple introduced Advanced Typography (AAT) with **Multiple master fonts**. These are “Type 1 font programs that include two or more “master” fonts within a single font file. It allows users to interpolate many intermediate “instances” of the typeface. The fonts have one or more “axes” which might typically represent the weight, width, or optical size of the font.”

- Seen as to unpractical it was widely adopted and used.

**1993**

FontLab 2.0 for Microsoft Windows was released.

**January 1995**

Altsys was acquired by Macromedia which included then a new version of Fontographer in the Macromedia Graphics Suite, which helped Fontographer’s wider adoption.

- Fontographer could now be used with RoboFog made by Erik van Blokland and Just van Rossum that brought, together with FogQ, Python scripting to Fontographer. With this combination repetitive tasks could be automated. (When later Fontographer was discontinued and a lot of people switched to FontLab. For it RoboFog was rewritten and called RoboFab).49

**September 1995**

“**The Letter Spirit** project is an attempt to find out more about [...] the creative act of artistic letter-design. The aim is to model how the 26 lower case letters of the roman alphabet can be rendered in many different but internally coherent styles.”

- “Starting with one or more seed letters representing the beginnings of a style, the program will attempt to create the rest of the alphabet in such a way that all 26 letters share that same style, or spirit.”50

In 2002 the Swiss design studio Norm published a similar attempt with their program **Sign-generator 1.0.51**

**1996**

The specifications for **OpenType** got announced by Microsoft and Adobe.52 This new font format is a subset of both the PostScript Type 1 and the TrueType format.

- It is platform independent, has many typographical feature possibilities and a better unicode support.53
- But it took longer than 2000 before the first OpenType typefaces were commercially available.

**1997**

Monotype Typography was taken over by AGFA forming AGFA Monotype.

**1998**

FontLab 3 for Mac was released.

The images above show some types of connections used in the internal structure of a font design tool developed by Changyuhan Hu for his Ph. D. thesis **Synthesis of Parametrisable Fonts by Shape Components** at the EPFL in Lausanne.

- It is interesting because he tried to deconstruct font characters into their essential parts and then used this imagined structure to reassemble a font just from it.

51 http://www.norm.to/pages/generator_3.html
52 http://www.cnet.com/Short-Specification-for-OpenType-available/2118-1001_3-226558.html
53 compare with http://de.wikipedia.org/wiki/OpenType Vergleich mit TrueType und PostScript

**1999**

Mac OS 9 integrated **TrueType** outline font support. Fonts could now be installed using drag-and-drop.

**November 7th, 2000**

PfaEdit (renamed to FontForge in 2004) was released by George Williams. It is an attempt to create an open source and free for all font editor.

**2001**

Microsoft introduces **ClearType** in Windows XP (though it was not activated by default until Windows Vista). It is an improvement of the former rendering of fonts especially on color LCD displays. This is quite important for fonts that are not hinted well.

**23 August 2002**

Mac OS X. Version 10.2 introduces **subpixel rendering** a technique similar to ClearType.

**October 2004**

Release of the **Unified Font Object** (UFO) at the ATypI meeting in Prague by Erik van Blokland and Just van Rossum. It is an open, application independent,
following the imaginary line that the hand would take when drawing a letter. It is possible to change the skeleton of every letter and the angle and the thickness of the pen for every node.\(^57\)

**Type Generator** designed and conceptualized by Remo Caminada and Ludovic Varone and programmed by Patrick Vuarnoz is a program that is able to generate letter forms in real time. Because the characters are defined by mathematical formulas a lot of different parameters can be adjusted and then will change the whole alphabet or just one letter. Afterwards the typeface can be exported as a vector path and used in other programs.\(^58\)

---

\(^54\) [http://unifiedfontobject.org](http://unifiedfontobject.org)


\(^56\) [http://www.genotyp.com/](http://www.genotyp.com/)

\(^57\) Source: [http://typemytype.com](http://typemytype.com)

\(^58\) Source: *Type Generator, User Instructions, Alphabet + Programm*, 2006 HGK Zürich. 1 Screenshot, Type Generator workspace, 2 User Utility Programm, S 5, 6, Parameter overview

---

\(^59\) [http://typophile.com/node/52821](http://typophile.com/node/52821)

\(^60\) [http://fontstruct.fontshop.com/learn_more](http://fontstruct.fontshop.com/learn_more)
Frank E. Blokland released the **DTL Letter Modeller**. It is a font construction program that is based on a calligraphic model that Edward Johnston used in the 1920s. The model has metaness features built in to make it possible to change certain variables and output a basic lower-case alphabet. Furthermore Frank E. Blokland has the idea that the model that he is using can also be taken to “measure” typefaces by comparing their characteristics to the most basic configuration of the DTL Letter Modeller. That is why he is working on a letter measurer, so that he can find out more about the rhythm (spacing, width) and the legibility of letters.

**2009**

“**Typism** is a web-based font editor. It is a public site where anyone can create a font for others to use and to study, to modify and to copy.”

**2010**

As part of a larger collection of scripts for FontLab the **RMX Harmonizer** from Tim Ahrens gives the possibility to harmonize Bézier curves and so helps to speed up the design process.

- Opening up again the debate about whether the computer is taking away too much of the responsibility from the type designer.

---

61 http://typophile.com/node/48736
62 http://typism.appspot.com/fonts/index
63 http://en.wikipedia.org/wiki/Web_Open_Font_Format
There are many ideas and concepts towards font design and how the design of a typeface should be tackled. That is why there are numerous ways on how programmers laid out software for the development of digital typefaces.

- The two main tasks when designing type are the definition of shapes and the combination of them. Therein we can find different approaches that will be analyzed in this chapter. It will be pointed out which program uses which approach with a discussion of what are the assets and drawbacks. Some programs, one being Metafont, even allow the combination of two or more of those approaches.

The first signs left by man were the prints of their foot steps in sand and soft soil. The first signs consciously created by man were probably written with the index finger or a stick in the sand, then later carved in wax, wood and stone which would finally preserve the traces for centuries.

- The foot would leave a complete shape with one print, making it the ancestor of today’s often used outline approach. The finger however, would create a thick line that would follow its movement making it the forerunner of the calligraphic approach. Later shapes would also be drawn from the outside what took more time but would also give new stylistic possibilities. So from the very beginning both approaches would coexist as calligraphy and punchcutting coexisted.

- Also found objects like stones would be used to create shapes and are today known as the mosaics or grid approach.

---

1 Starting points for this kind of comparison can be found in the “research project generating fontdesign” by Frederik Barlaen, Jürg Lehni, Ian Party, François Rappo and Ludovic Varone.
Calligraphic or Skeleton Approach

How it works
- Originated from linear-drawing, writing and calligraphy where different kinds of pens (pointed, broad-nib, ...) get applied to a skeleton resulting in different kind of characters depending on the pen.

Example Programs
- **Illustrator** has many tools to make fonts with a bone structure (and all kind of other vector deformation), but there is no font export
- **Metafont** uses formulas and parameters to change the bone structure
- **Calligrapher** from Jürg Lehni and François Rappo
- **Kalliculator** uses hand placed skeletons with a very sophisticated brush model

Outline Approach

How it works
- Originated from the drawing of letters rather then the writing of them, different kinds of tools allow to change the outline of each glyph. Sometimes referred to as “sculpting” this approach has not changed much since its introduction in Fontographer.

Example Programs
- **FontLab** and **Fontographer** (Bézier curves) require a lot of experience to make the curves harmonic.
- **Ikarus** needs a point each 30°, which results in a lot of points, it is a good program to digitize a font.
- **Metafont** uses curves and formulas together with parameters, but is not very intuitive, because there is no graphical user interface. If one outline has metaness included then it can be used to generate numerous shapes, but they are at the same time very hard to control.
- **Spiro curves** (see also page 22) are a more intuitive approach than Bézier curves, they are harder to control, but have better joints.
- **ARAP** (As-rigid-as-possible) is used for a very intuitive shape deformation, but it is at the same time probably harder to achieve very exact results.

Mosaic or Grid Approach

How it works
A grid defines where different kind of strokes or parts can go. Originally used to cover surfaces with tiles and called a mosaic many grids have been refined and adapted to better suit the construction principles of fonts.

Example Programs
- **Pixelfonts** were a necessity when displays changed from vector to bitmap. In a way it is still the standard today for screen displays. But today the pixelized letters are derived from vector versions. And only very few fonts get a special so called hand hinted version, where the letters get optimized for special pixel sizes.
- **Fontstruct** is an online tool which makes it very easy to share your font design.
- **DutchLettermodeller** is programmed to use relations based on a calligraphic model but the actual rendering is more related to a grid approach.

Inter- and Extrapolation

How it works
A software tries to analyze already existing glyphs and inter- and extrapolates between their maxima. It works best to interpolate in between different weights and widths of the same font but it can also be used to interpolate in between different fonts. Most of the time it produces an unforeseen and more experimental new font.

Example Programs
- **Multiple Master Fonts**
- **Extrapolating functions in Fontlab**
- **Superpolator**
- **GenoTyp**
Combining Shapes

The combination of shapes is an approach that can already be observed with the use of counter punches in the early metal type design. Its scope can be advanced by looking at Oswald Cooper’s work from 1936 (page 8), “which involved applying 15 serifs [...] to stems of similar weight to test their influence in letter design”\(^4\) or Matthew Carter’s work for the Walker Art Center\(^5\).

- But the process of combining shapes is not only important in the design process but can also be used in the type setting program. With the use of different OpenType features it can provide alternate letters or ligatures. This is especially important for Arabic typefaces or lots of typefaces that try to simulate handwriting.

\(^5\) Matthew Carter http://design.walkerart.org/detail.wac?id=2098&title=Articles
Self Organizing Shapes

The method that Changyuhan Hu introduced with his PhD-thesis “Synthesis of Parametrisable Fonts by Shape Components” at the EPFL in Lausanne in 1998 offers a flexible font description. Characters are derived by an “assembly of structure elements (stems, bars, serifs, round parts, and arches)” 6.

- In my eyes the underlying model is a great idea because it captures the fundamental model of type design. And it definitely takes care that the font gets a high consistency. I am not sure though if the implementation is as flexible as the ground model as I have not seen the program in use. It is obviously quite good in recreating fonts, but it is not clear if it can create new fonts.

---

6 Changyuhan Hu, Roger D. Hersch. Ecole Polytechnique Fédérale de Lausanne, Switzerland. Parameterizable Fonts Based on Shape Components. Page 1
“Electronics will soon force its claims upon letterforms, and let us hope it will liberate us from the dust of the past.”

Hermann Zapf, 1968

“Woe, if the machine wins out and the characters are shaped after its judgment! Who will then need to wonder if the emergent letter is cold and soulless?”

Hermann Zapf, 1970

---

1 Letterform Design Systems by Lynn Ruggles, Page 1

1 Tim Ahrens – Size-specific adjustments to type designs. Page 24