

The concrete-vec package

Concrete text and mathematics as outlines, with a bold weight

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Abstract

concrete-vec typesets a document in Donald Knuth's Concrete fonts with two properties the existing Concrete packages do not jointly provide: every glyph, in text *and* in mathematics, is a vector outline rather than a bitmap; and a bold weight is available, synthesised by stroking, in text and in mathematics. It is a thin configuration layer over ccfonts, mathastext and pdfrender, and targets pdf_latex.

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1 The problem

Knuth designed the Concrete Roman fonts for *Concrete Mathematics* and they are widely admired. Three LaTeX packages typeset with them: beton (text only), concmath and ccfonts (text and, in Concrete mathematics). Two limitations recur.

Bitmap mathematics. The Concrete text fonts have freely available Type 1 outlines, but only in the T1/TS1 (“Cork”) encoding: these are the ecc metrics, mapped to Type 1 by cm-super. The Concrete *math* fonts (Ulrik Vieth’s concmath-fonts) ship as METAFONT source only, and cm-super does not cover them. Consequently a document using concmath or ccfonts for mathematics embeds *bitmap* (Type 3) math fonts, which look poor on screen and do not scale. The text can be vector while the mathematics is not.

No bold. There is no bold Concrete font. Worse, t1ccr.fd silently substitutes T1/ccr/bx/* by Computer Modern bold, so \textbf in an otherwise Concrete document quietly changes typeface; and T1/ccr/b/* is undefined, so on a current LaTeX (which requests series b first) headings and \textbf may

receive no extra weight at all. The traditional remedy—the Computer Modern sans demibold condensed as a stand-in (ccfonts’ boldsans option)—changes both typeface and style.

What is new here. An OpenType Concrete math font now exists (concmath-otf, with a genuine bold), and the classic all-vector route is ccfonts with Euler mathematics (eulervm), as Knuth actually used. Both are excellent, but neither gives *Concrete letterforms in mathematics under pdf_latex*. That is the niche concrete-vec fills.

2 The approach

1. **T1 output encoding.** The only encoding in which Concrete has free outlines. The package sets it and warns if the default text encoding is not T1 at `\begin{document}`.
2. **Vector mathematics via mathastext.** mathastext reuses the current *text* font for the letters, digits and operators of math mode. With Concrete as the text font, math letters become Concrete outlines. Symbols, delimiters and large operators fall back to Latin Modern (also vector).
3. **Synthetic bold by stroking.** PDF text rendering mode 2 both fills and strokes each glyph, so a medium outline gains weight from a chosen stroke width. The package patches `\bfseries` (not merely `\textbf`), so bold works in headings, tables and list labels; and it provides `\bd`, which bolds any single math symbol—Latin, Greek or other—in *place*, keeping its existing shape. Genuine bold designs (sans, typewriter) are left untouched. The same stroking idea is packaged independently as xfakebold.

3 Usage

```
\usepackage{amsmath}      % load amsmath/amssymb first, if wanted
\usepackage{concrete-vec} % ... then load this package last
```

Load concrete-vec *after* amsmath and any other math package, because mathastext must be the last math package read. That is the only ordering rule.

3.1 A minimal document

```
\documentclass{article}
\usepackage{amsmath}
\usepackage{concrete-vec}
\begin{document}
Concrete text, with \textbf{simulated bold} and \emph{italic}.
\begin{align}
\mathrm{d}X_t &= \mu(X_t)\mathrm{d}t + \sigma(X_t)\mathrm{d}W_t, &
\mathrm{d}v \cdot \mathrm{d}w &= \sum_{i=1}^n v_i w_i, & \mathrm{d}\pi &\approx 3.14.
\end{align}
\end{document}
```

Here `\bd` bolds each symbol in place: ***v*** and ***w*** stay italic, **π** is a genuine bold π—something `\mathbf` cannot produce. The same `\bd` also works in running text (there it is ordinary bold), so a single command serves both modes.

3.2 This manual

This document is itself typeset with concrete-vec, so its body text, headings and every formula are live examples. For instance

$$u(t, x) = \mathbb{E} \left[\int_t^T e^{-r(s-t)} f(X_s) \mathrm{d}s \mid X_t = x \right], \quad \alpha, \beta, \gamma, \Gamma, \Lambda, \Omega \in \mathbb{R},$$

and **A*****x*** = **b** shows bold letters in mathematics next to the ordinary weight *Ax = b*; note that *x* keeps its italic shape.

4 Options

All options are key/value or plain switches; unknown options are passed on to `mathastext`, so its options (e.g. `italic`, `subdued`) may be given here directly.

bold / nobold (default `bold`)
Enable or disable synthetic bold entirely. With `nobold`, `\bfseries` is left as LaTeX found it.

boldwidth=<dimen> (default `0.03em`)
Stroke width for synthetic bold. `0.03em` is 0.3 pt at 10 pt and scales with the type size. Heavier values (e.g. `0.4pt`) give a bolder weight. Also settable mid-document with `\setconcreteboldwidth`.

mathbold / nomathbold (default `nomathbold`)
By default `\mathbf` is left as the standard upright Latin bold alphabet, and `\bd` is the way to bold a math symbol. Pass `mathbold` to instead reroute `\mathbf` (and `\boldsymbol`) through the in-place stroke, so that `\mathbf` too preserves shape and accepts any symbol. Provided mainly for backward compatibility.

math / nomath (default `math`)
Whether to configure mathematics at all. `nomath` gives Concrete text with the document's existing math setup untouched.

greek=<value> (default `lgr`)
Source of Greek letters in math: `lgr` (the CB Greek fonts, via `mathastext`'s `LGRgreek`), `euler`, `symbol`, or `none`. All are vector.

frenchmath / nofrenchmath (default `frenchmath`)
Passes `frenchmath` to `mathastext`: upright uppercase *and* lowercase Greek, and upright operator names.

lmodern / nolmodern (default `lmodern`)
Whether to load `lmodern` for the sans, typewriter and math-symbol slots. With `nolmodern`, `cm-super` still supplies vector fonts for those.

5 Commands

\bd{...} The main tool, and it works in *both* modes. In running text it is ordinary bold (like `\textbf`). In mathematics it bolds by thickening the glyph *in place*, so it keeps whatever shape it already has and works on any symbol, not just Latin letters: $\boldsymbol{x}$ is the italic x made heavy, $\boldsymbol{\pi}$ a bold π , $\boldsymbol{\Gamma}$ a bold upright Γ . One command covers `\bd{a heading}` and `\bd{\alpha}` alike.

\mathbold{...} Strokes a whole subformula, e.g. `\mathbold{\alpha + \sum_i x_i}` gives $\boldsymbol{\alpha + \sum_i x_i}$. `\bd` and `\mathbold` are the same operation; use whichever name reads better.

\concretebold, \concretenobold Switch stroking on/off for the text that follows, within the current group. Rarely needed directly.

\setconcreteboldwidth{<dimen>} Change the stroke width mid-document.

In mathematics `\bd` bolds the glyph by drawing its outline thicker, so an italic letter stays italic—only the strokes get heavier. That is usually what is wanted when emphasising a variable, and it is the one thing `\mathbf` cannot do, since `\mathbf` switches to an upright bold alphabet.

6 How the bold works, and its limits

Synthetic bold is a fill-and-stroke, not a redrawn typeface. It is convincing at text sizes and for emphasis, but:

- It thickens stems uniformly and does not reproduce the optical refinements of a true bold design.
- At very large sizes, or very heavy `boldwidth`, the outline can look slightly inked; reduce `boldwidth` for display sizes.

- It requires a PDF-producing engine: `pdflatex`, or `lualatex`. It has no effect with DVI-only workflows.

Bold is applied only where the current family is Concrete, so `\textsf` and `\texttt` keep their genuine Latin Modern bold rather than being double-stroked.

7 Requirements

A T1-encoded Concrete document needs, beyond a standard $\text{T}_{\text{E}}\text{X}$ Live or $\text{MiK}_{\text{T}}\text{T}_{\text{E}}\text{X}$: the `ccfonts` package (for `t1ccr.fd`), the ecc font metrics, and the `cm-super` outlines; `mathastext`; `pdfrender`; and, for `greek=lgr`, the CB Greek fonts (`cbfonts`, `cbfonts-fd`). All are free and present in a full distribution.

8 License

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