

Command Line Algorithmic Music System (CLAMS)

M. Edward (Ed) Borasky

2023-02-23

Me and Forth

Me - retired scientific applications programmer

- ▶ I got paid to write
 - ▶ Assembly
 - ▶ Fortran
 - ▶ Awk / sed / grep / *nix shell
 - ▶ Perl
 - ▶ R

I learned for hobby projects

- ▶ Lisp
- ▶ Forth
- ▶ Ruby

I never learned

- ▶ APL
- ▶ C/C++ / Java / C# / Objective C / D / Rust / Go
- ▶ PHP
- ▶ Python
- ▶ JavaScript

Forth

- ▶ late 1980s
 - ▶ learned Forth via HESForth on Commodore 64
- ▶ mid-late 1990s
 - ▶ primary Forth engine was HP100LX Palmtop PC
 - ▶ wrote some articles for FORTH Dimensions
 - ▶ wrote some trading system software
 - ▶ used mostly hforth and Tom Almy's Forth compiler
 - ▶ later ran the Forth from Jack Woehr's *Forth: The New Model*
 - ▶ Google is drawing a blank on which Forth that was

Why I stopped writing Forth

- ▶ by 1999 I had faster machines that ran my code in Perl
- ▶ I wasn't using it at work
- ▶ I was learning Linux and R at work

(Two sunspot cycles pass ...)

He's baaack! And he brought ... CLAMS!

CLAMS goal

- ▶ algorithmic music composition and performance ...
- ▶ live ...
- ▶ in real time ...
- ▶ on a Raspberry Pi Pico!

Inspirations

- ▶ Hierarchical Music Specification Language (HMSL)
 - ▶ long history and experience with experimental composers
 - ▶ currently being actively enhanced!
 - ▶ <https://github.com/philburk/hmsl.git>
- ▶ FORMULA - FORth MUsic LAnguage
 - ▶ designed for improvisation in real time
 - ▶ contained a real-time operating system
 - ▶ David P. Anderson and Kuivila (1989), D. P. Anderson and Kuivila (1991)
- ▶ *Live Coding: A User's Manual* (Blackwell et al. 2022)

CLAMS architecture

- ▶ a domain-specific language implemented in Forth
- ▶ conceptually, ChuckK (<https://chuck.cs.princeton.edu/>), (Salazar et al. 2014) semantics with Forth syntax
 - ▶ low-level words: digital synthesis and microcontroller audio
 - ▶ mid-level words: construct signal flow graph
 - ▶ high-level words: provide performance interface

Forth base: zeptoforth

Highly optimized!

- ▶ subroutine-threaded
- ▶ allows inline expansion of words
- ▶ many primitives in assembly

Close to the metal

- ▶ word sets for nearly all the RP2040 hardware
- ▶ has an RP2040 assembler
- ▶ can compile to RAM or flash
- ▶ real-time operating system capabilities

zeptoforth on GitHub

- ▶ repository: <https://github.com/tabemann/zeptoforth>
- ▶ wiki: <https://github.com/tabemann/zeptoforth/wiki>

Road map

Initial hardware: Pimoroni Pico Audio Pack

- ▶ <https://shop.pimoroni.com/products/pico-audio-pack>

Proof of concept (v0.2.5)

- ▶ direct digital synthesis
- ▶ sine / triangle / sawtooth / pulse wave of any frequency
- ▶ maybe a filter and envelope generator and low-frequency oscillator
- ▶ maybe two oscillators and frequency modulation
- ▶ early to mid March

First release (v0.5.0)

- ▶ all synthesis / audio I/O words
- ▶ goal is everything you can do in Csound 7
 - ▶ <https://flossmanual.csound.com/>
- ▶ late March / early April

Second release (v0.7.5)

- ▶ signal flow graph
- ▶ possibly other RP2040-based hardware
- ▶ late April / early May

Full release (v1.0.0)

- ▶ live performance user interface
- ▶ possibly other microcontroller audio hardware
- ▶ optimistically, late July
- ▶ realistically, September
 - ▶ I want something other people can use at this point!

CLAMS on the web

- ▶ GitHub: <https://github.com/AlgoCompSynth/CLAMS>
- ▶ blog: <https://algocompsynth.github.io/CLAMS-Blog/>
- ▶ this presentation: <https://github.com/AlgoCompSynth/CLAMS/blob/main/presentations/CLAMS-intro.pdf>

References

- Anderson, D. P., and R. Kiuivila. 1991. "Formula: a programming language for expressive computer music." *IEEE Computer* 24 (7): 12–21. <https://doi.org/10.1109/2.84829>.
- Anderson, David P., and Ron Kuivila. 1989. "Continuous Abstractions for Discrete Event Languages." *Computer Music Journal* 13 (3): 11–23. <http://www.jstor.org/stable/3680007>.
- Blackwell, A. F., E. Cocker, G. Cox, A. McLean, and T. Magnusson. 2022. *Live Coding: A User's Manual*. Software Studies. MIT Press.
- Salazar, S., A. Kapur, G. Wang, and P. Cook. 2014. *Programming for Musicians and Digital Artists: Creating Music with Chuck*. Manning.