conFFTi — FPGA music synthesizer

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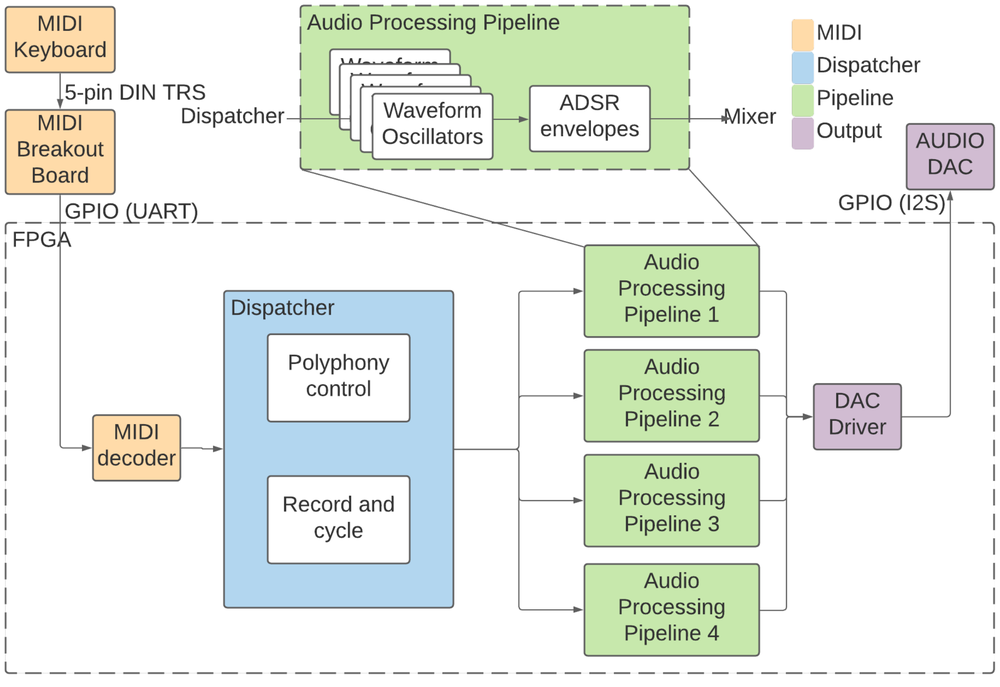
Product Pitch

conFFTi is a digital music synthesizer implemented on an FPGA.

It accepts real-time input from a MIDI keyboard, generates and processes audio signals, and outputs **44.1kHz, 16-bit, 2 channel** signals through an audio DAC.

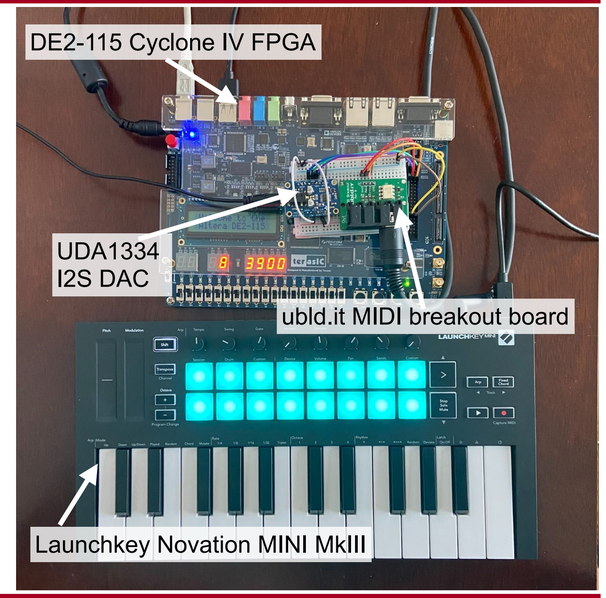
conFFTi has a very low latency of **3.3ms**, minimal shape distortion of less than **1%**, and low frequency distortion of less than **10 cents** across notes from C0 to C6.

System Architecture



System Description

- **4-note polyphony**
  - Play up to 4 musical notes at the same time!
- **8 waveforms** to select from the FPGA switches
  - Basic waveforms: square, triangle, sine
  - Special wavetables: violin, viola, cello, trumpet, french horn
- **ADSR**
  - Adjust attack, decay, release and sustain levels via keyboard knobs
- **Pulse width modulation (PWM)**
  - Adjust waveform duty cycle via keyboard knob
- **Unison detune**
  - Thicken the sound by adjusting keyboard knob
- **Record and cycle**
  - Hold down the record key, play up to 4 notes
  - Press play button to loop the recording



System Evaluation

Latency (including DAC)	3.30ms
Latency (except DAC)	940us

Fig. A. Latency from MIDI to DAC is below the 10ms requirement and is undetectable by human ears

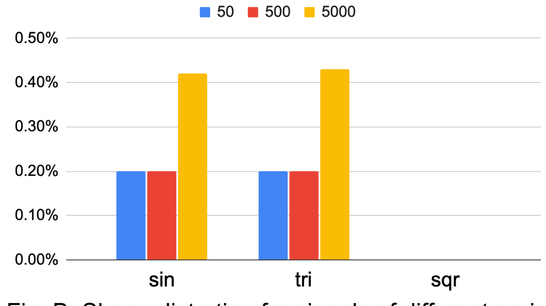


Fig. B. Shape distortion for signals of different periods; 1% deviation requirement met for all signals

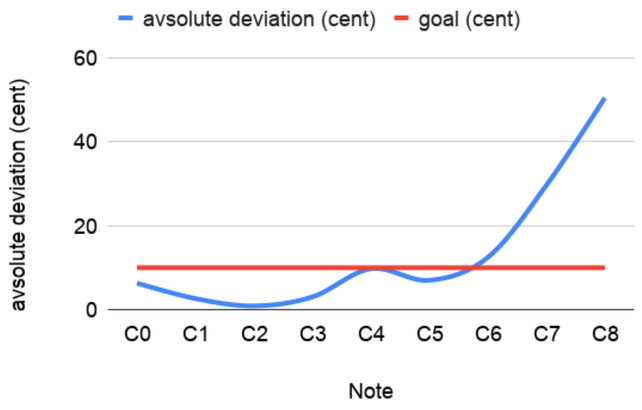


Fig. C. Pitch deviation across all octaves measured in cents; Notes above C6 are not meeting the requirement of less than 10 cents