Digital Supersaw Synthesizer

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6.111 Fall 2018

In decades past, electronic music was generated in the analog realm. Audio synthesizers were expensive, heavy, and prone to the same problems as in other integrated circuits. With the increase in transistor density and refinement of the processor, more and more complicated tasks are being performed in the digital realm. There are many software programs meant to perform the same functions as their analog predecessors, but few all-digital synthesizers have been created that satisfy the electronic music creators. Indeed, musicians are hard to please.

We propose to design and build a multi-voice, configurable digital synthesizer, allowing a user to play notes/melodies on a MIDI keyboard, adjust for desired sound features, and hear the synthesized result through a standard audio interface. In addition, we plan to display the output waveform in real-time over VGA. The Nexys 4 DDR Artix-7 FPGA board offers high frequency (>100 kHz) low-pass filtered PWM output which we will use as a mono audio interface, while the onboard 12-bit VGA will provide the user with visual feedback. We plan to base the overall design on the commercially-available JP6K VST synthesizer plugin, which emulates the analog "Supersaw" waveform known in the EDM industry as the de-facto standard for trance leads. The Supersaw consists of two sets of seven detuned and phase-shifted sawtooth waves, where the inter-set mix level is adjustable and the intra-set phase-shift amounts are random. The number of voices (simultaneous notes) will be set to 8 or 10. Time permitting, we will incorporate as many of the following functional blocks as possible: detune control, noise generator, low-frequency oscillator (LFO), ADSR envelope generator, arpeggiator, delay, and reverberation, for the most accurate synthesizer replication.