BE2M31SYN – Synthesis of Audio Signals

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Semestral Project

My objective was to create a useful GUI for light MIDI file info viewing and applying sound effects to separate instruments and play tracks using MIDI Toolbox. After creating this GUI I was able to create a soundfont (synthesize sounds for each instrument) for two MIDI tracks (HOME – Resonance, Depeche Mode – Policy of Truth) and apply sound effects such as reverb, delay and chorus to chosen instruments.

First, after finding the right MIDI files, I had to convert them from type 1 to type 0. I used GNMIDI software for this task.

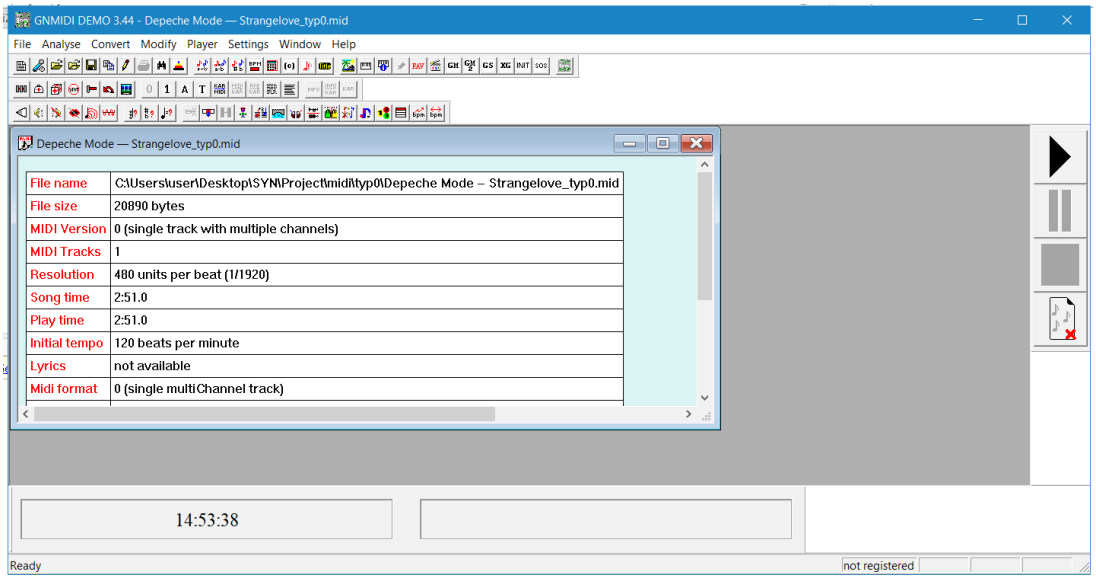

Fig. 1. GNMIDI

The GUI, called ‘MIDI Wizard’ was created in MATLAB GUIDE. User is able to select a folder with MIDI files which is then scanned automatically, apply FX to instruments, convert MIDI to .WAV file and play the created file. It looks and feels like a standalone program. To launch it, the user only has to execute the script “midihelper.m” or type “midihelper” in the MATLAB console.

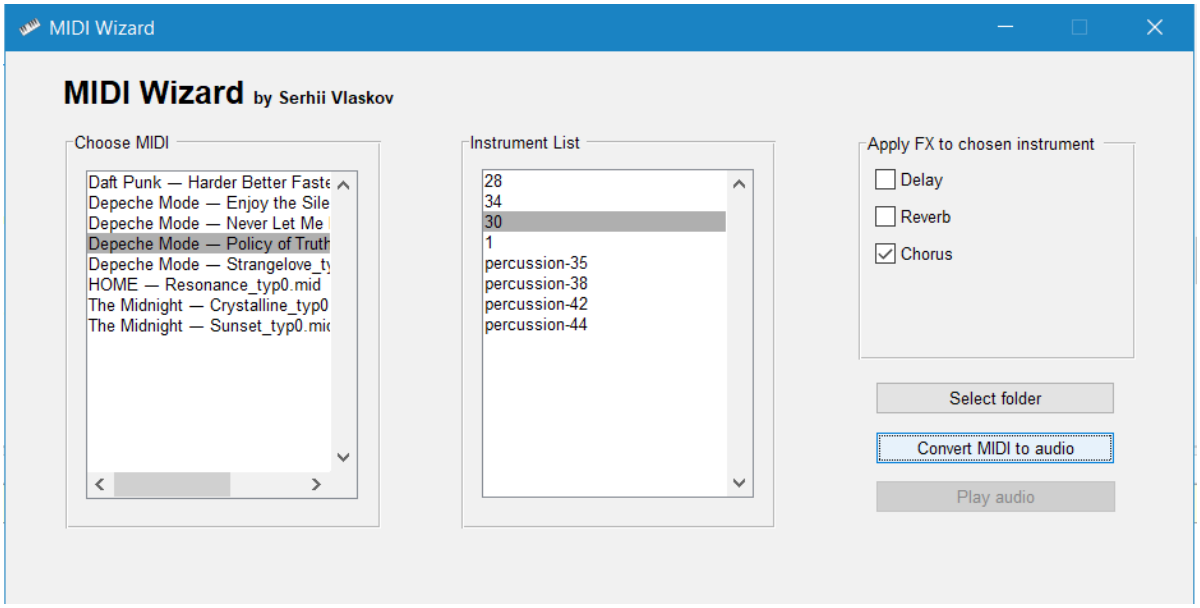

Fig. 2. Project: GUI for MIDI file manipulation

Some instruments in the output tracks were replaced to my liking:

- Harpsichord (7) → Synthetic marimba;
- Clean electric guitar (28) → Grand piano;
- Overdriven guitar (30) → Steel guitar;
- Fingered electric bass (34) → FM synth bass;
- Bass Lead (88) → Waveshaping strings;
- Atmosphere effect (100) → Synth brass.

Each instrument was synthesized using different synthesis methods. For example, to create the sound of grand piano and steel guitar, the Karplus-Strong algorithm was used. Piano's impulse response had to be included in the files. Due to complexity of the algorithm the sounds produced are quite realistic. Applying chorus to guitar results in a sound similar to 12-string guitar.

Synth bass, brass and marimba were synthesized using FM synthesis. The synth bass in particular is rich in harmonics, and both marimba and bass have very

sharp attack. Waveshaping using nonlinear function (hyperbolic tanhent) was employed to create a smooth synth string sound.

To synthesize the drums (kick, snare), I used LPC. The best sound for the kick could be produced by using either part of sinc function or reversed linear chirp. Due to large amount of percussion in some of the track, the rest of percussion is created with white noise.

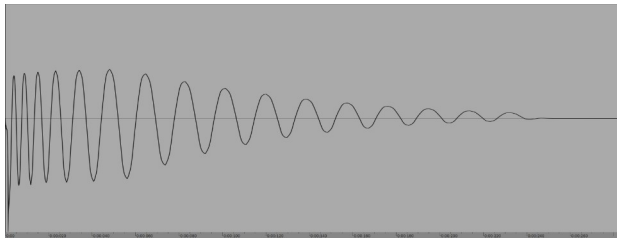

Fig. 3. Similar kick sound plot

As was mentioned earlier, this program has the capability to apply different sound effects to separate instruments. Such effects include simple delay, all-pass filter reverb, and chorus. The original functions from MIDI Toolbox were modified to include *fx_state* as an argument, which represents the state of FX checkboxes for each instrument for a given MIDI track. The effects chain order of application goes like this:

delay → reverb → chorus

Indeed, there are some issues. Audio files with applied effects are processed much longer than those without. For instance, the reverb is quite a complex effect to synthesize compared to delay and the track requires much more time to be processed. The same may apply for chorus.