

Synth challenge 2020

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December 19, 2020

Synthesis of the song **Take on me**

There are 8 instruments in the song: oboe, clarinet, flute, guitar, bass guitar, harp, piano and violin.

Various techniques were used to synthesize them. Violin and clarinet were synthesized using a formant synthesis. Excitation is done by sawtooth and by square waves respectively. Additive synthesis was used in cases of flute and oboe. The rest of instruments were synthesized by wavetable synthesis.

Important part of synthesis was an envelope. In the case of string instruments (except of the violin) was used the exponential envelope. The ADSR envelope was used for the rest of instruments. The coefficients of each envelope were tuned for each instrument separately in order to get the best performance of designed synthesis.

In the case of the bass guitar (which plays important part in this particular song) was added a convolution reverb of a real amplifier. Convolution reverb of a direct cabinet was applied on the whole song so the song sounds more realistic.

Synthesis of the passing train sound

In the freestyle category of the competition I have decided to synthesize sound of a passing steam train. The whole audio track consists of a mixture of 4 sounds: sound of a steam engine, its bell and whistle and sound of train bogies.

The well known sound of a steam locomotive was achieved by amplitude modulation of the white noise. The modulating signal is sawtooth and its frequency determines speed of the train. Because the frequency is increasing in the time, it sounds like the train is picking up speed.

The frequency modulation and exponential envelope were used in order to synthesize the sound of a locomotive bell. Old locomotive bells have a special style of control which causes that the clapper hits the bell mouth two (or more) times. It can be seen in the video [1]. This behaviour is simulated by an echo effect.

The sound of a locomotive whistle was synthesized by a formant synthesis. Excitation of the formants is done by square wave. Resonance frequencies and bandwidths of each formant were tuned on the basis of spectral analysis of real whistle sound. The ADSR envelope is added.

Last sound is a bogie sound. A single strike (of a wheel on a rail joint) was performed using a filtration synthesis with IIR filter, excitation by white noise and exponential envelope. These

single strikes are repeated after proper time intervals. As the train is picking up speed the time intervals are decreasing. The echo effect was used again in order to support impression of more coaches in the train.

Important part of the whole track is envelope. As time goes on, the locomotive is passing away so its sounds volume is decreasing. But more and more coaches are passing by the listener so the bogie sound volume is increasing in the time.

The reverb of a cement block was added so the final sound supports impression of a railway station.

References

- [1] The real locomotive bell sound, <https://www.youtube.com/watch?v=jMQR0pQDG7c>