Synthesis of song Take On Me (By A-Ha)

I started by listening to original song and compare midi file with that. A read few articles about this song and find out that the main bass part is composed on legendary synth Yamaha DX7[1]. I compared a_ha.mid file with original song and deduced, that this part is labeled as synthtype 1. This synthtype should be Acoustic Grand Piano according to pdf Midi_instrument_table, but i tried to imitate the original sound, which came up not so good. I used two oscillators, one sawtooth type and square type and mixed them together. Afterwards I used low pass filter with cutoff frequency 300Hz. After this i decided to go strictly by instruments, that are described in pdf file.

Synthtype 72 – clarinet

- Formant synthesis with 350 Hz (bandwidth 450 Hz), 830 Hz (bandwidth 450 Hz), 2190 Hz (bandwidth 900), 3880 Hz (bandwidth 675 Hz) formants
- Oscillator type: triangle

Synthtype 69 – Oboe

- Formant synthesis with 1600 Hz (bandwidth 100 Hz) formant
- Oscillator type: square
- Filter with cut off frequency 2500

Synthtype 41 – Violin

- Formant synthesis with 300 Hz (bandwidth 300 Hz), 700 Hz (bandwidth 200 Hz), 3000 Hz (bandwidth 700 Hz) formants
- Frequency modulation – effect of vibrato

Synthtype 35 – Plucked bass guitar

- Additive synthesis – first 10 harmonics
- Oscillator type: sinus
- Significant envelope: fast attack and exponential decay

Synthtype 24 – Nylon acoustic guitar

- Additive synthesis – first three odd harmonics (1.,3.,5.)
- Oscillator type: sinus
- Envelope same as bass guitar
- There should be some vibrato effect, but I had problem to implement it.

Synthtype 47 – Harp

- Only instrument I did not know at all how to synthesis so I made my own sound using additive synthesis (similar to guitars) and I used frequency modulation.
- Main oscillator type: sinus
- Modulation oscillator type: sinus

Synthtype 74 – Flute

- I had problem with this code, so I had to let it out. I left it in the synth.m code commented.

[1] https://www.soundonsound.com/people/ha-take-me

Own synthesis

For my own sound I chose to imitate sound of lightsabers from Star Wars series. I read that original creator Ben Burtt used an old projector for humming sound and old TV for buzzing sound (sawtooth). He mixed these two elements and played them from speaker. Afterwards he waved with microphones in front of a speaker according to actor's movement. My implementation:

- hum sound:
    - three oscillators: sawtooth (89 Hz), square (87 Hz), square (20 Hz).
    - filter with cut off frequency 1500 Hz
    - Mixed with white noise
- buzz sound:
    - sawtooth oscillator with 50 Hz
- I mixed buzz and hum
- I used envelope to imitate movement with lightsaber
- Finally, I used filter with cut off frequency 6000 Hz