Sound Resynthesis with a Genetic Algorithm

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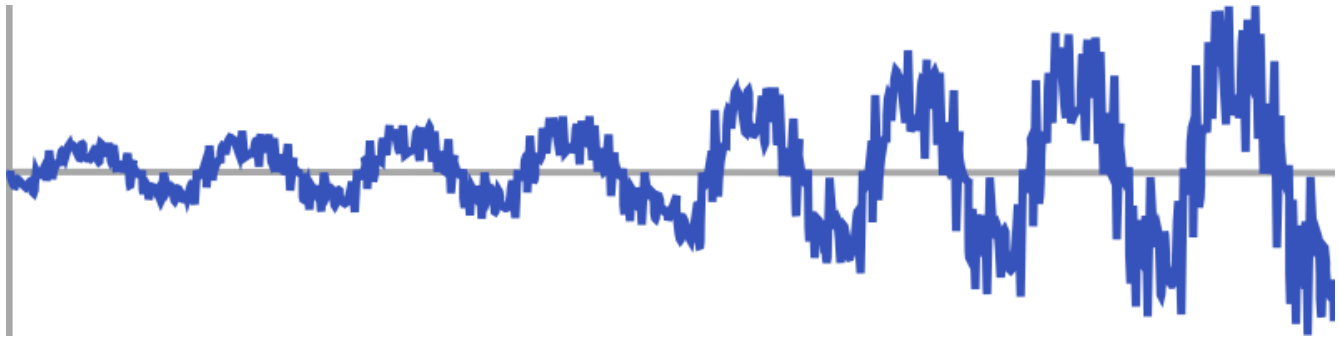
Synthesizers

Synthesizers

Idea

- Automate programming of synthesizer
- Aim to resynthesize a target sound from a recording



Previous Work

- 3 pieces that are similar to my idea
- All concerned with matching steady-state sound
- Simple synthesizer models employed

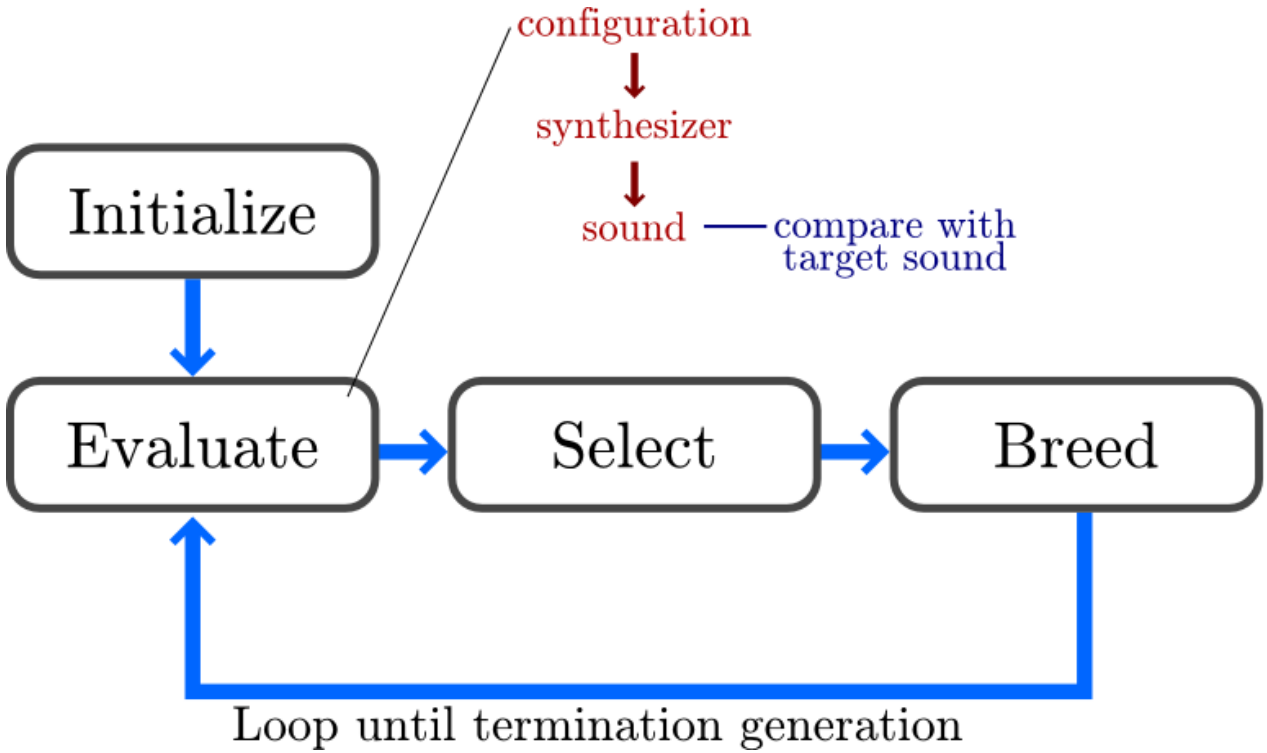
Search Algorithm

- Optimize many parameters in parallel
- Sound Designers work on 'intuition'
- No specific algorithm
- ∴ use general search technique

Genetic Algorithm

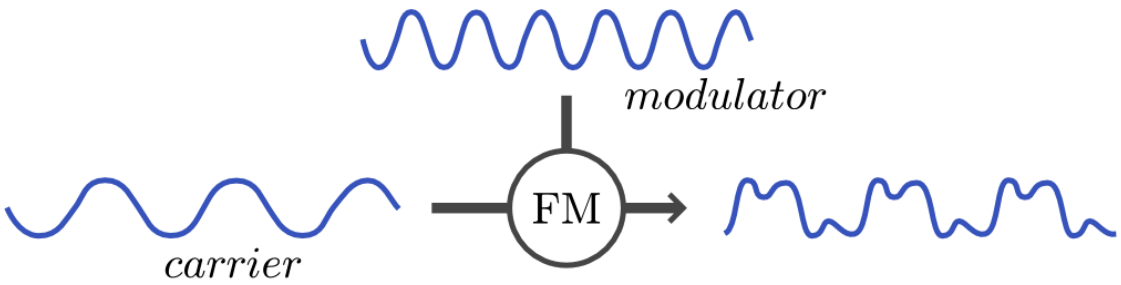
- Natural Selection : Survival of the Fittest
- Evolve best configuration of synthesizer parameters
- Fittest synthesizer configuration sounds closest to target sound

Outline


configuration
synthesizer
sound
compare with target sound
Initialize
Evaluate
Select
Breed
Loop until termination generation

Synthesizer Model

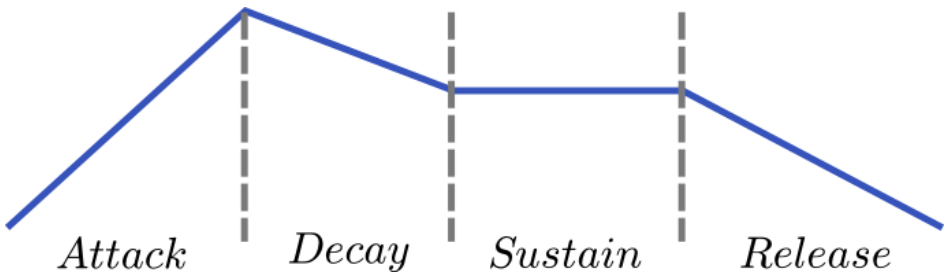
- Uses Frequency Modulation synthesis



- DFM Formula :
  $x(t) = A \sin[I_1 \sin(\omega_1 t) + I_2 \sin(\omega_2 t)]$

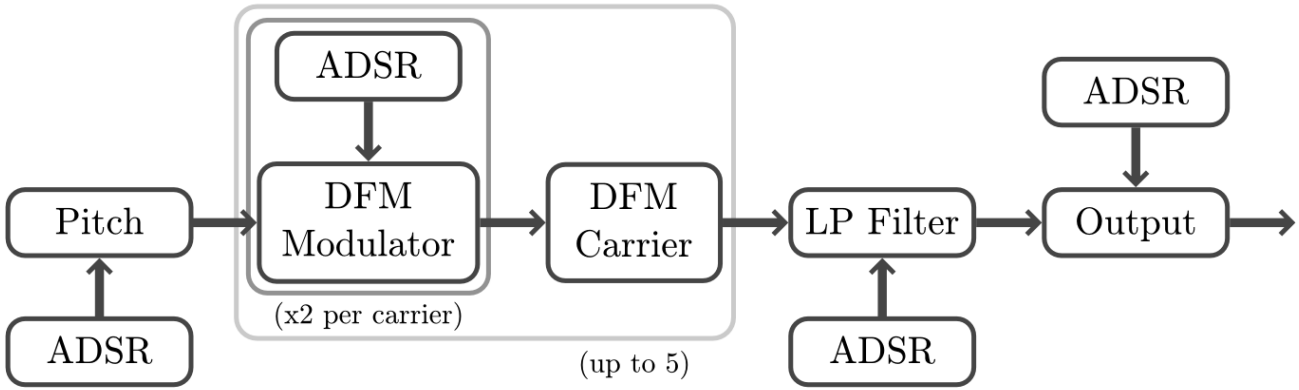
Synthesizer Model

- Add ability for sound to evolve over time with ADSR envelope:



- Similar to real world instruments

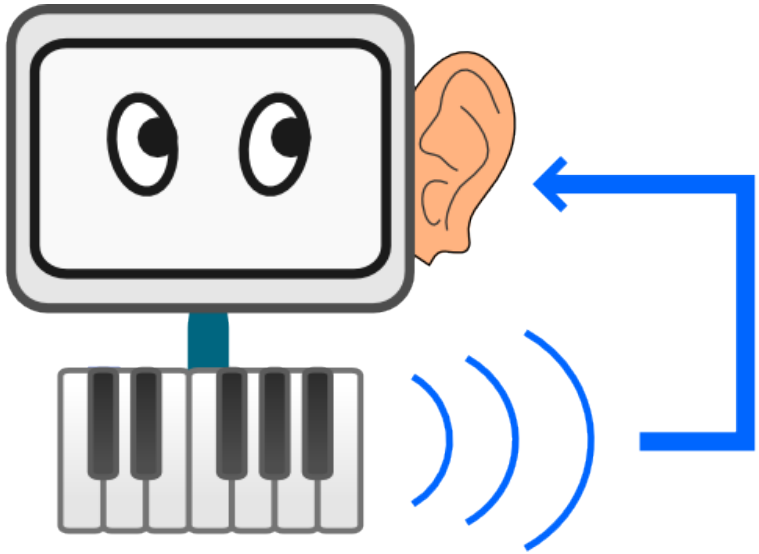
Synthesizer Model



- Total of 64 parameters

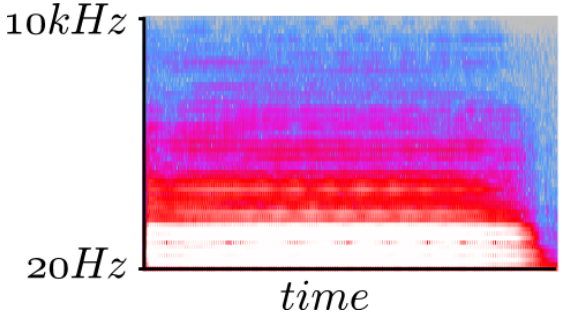
Sound Comparison

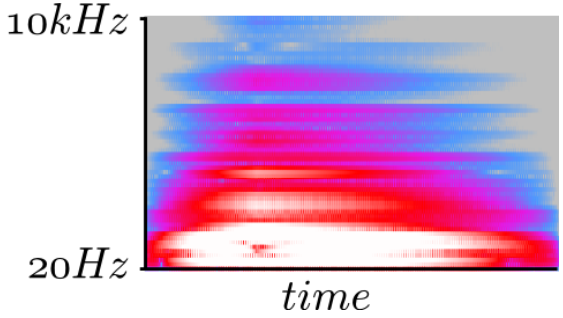
- Fittest synthesizer configuration *sounds closest to target sound*



Sound Comparison

- Spectrogram = Windowed FFT Analysis





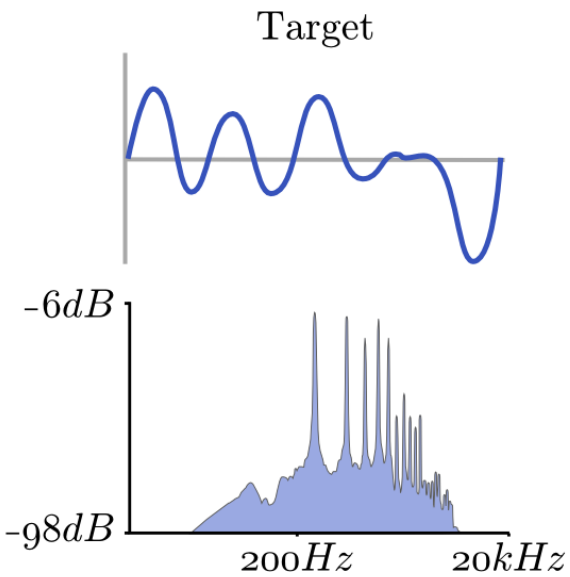
- Compare with sum of two metrics (in report) – results in error value
- System works to minimize this error

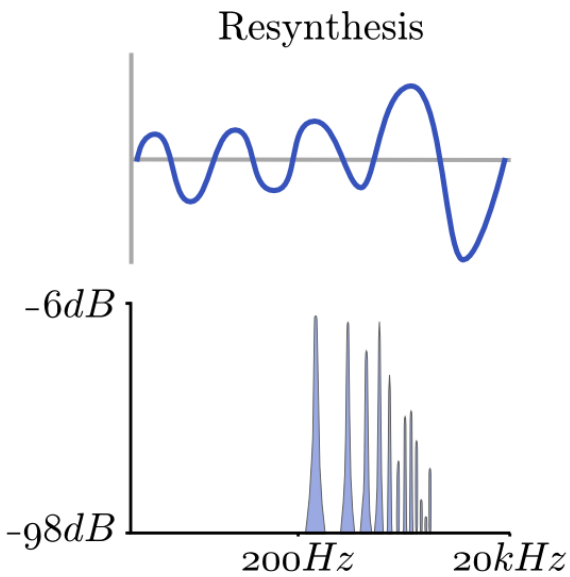
Demo

- And now, a demo...

Oboe

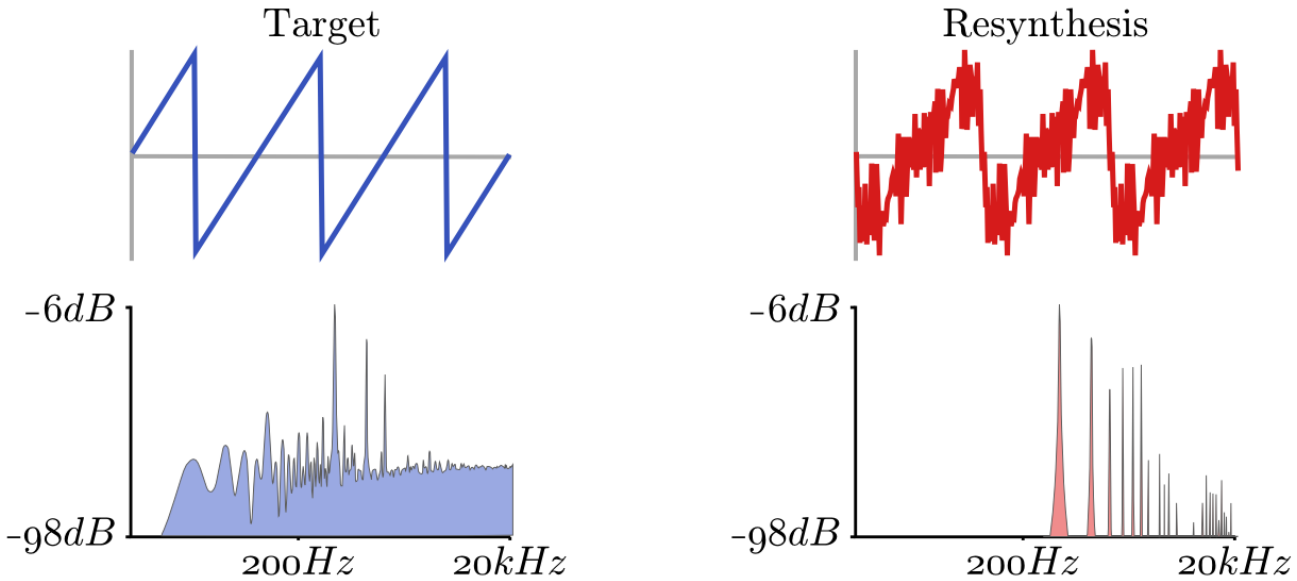
- A good match:





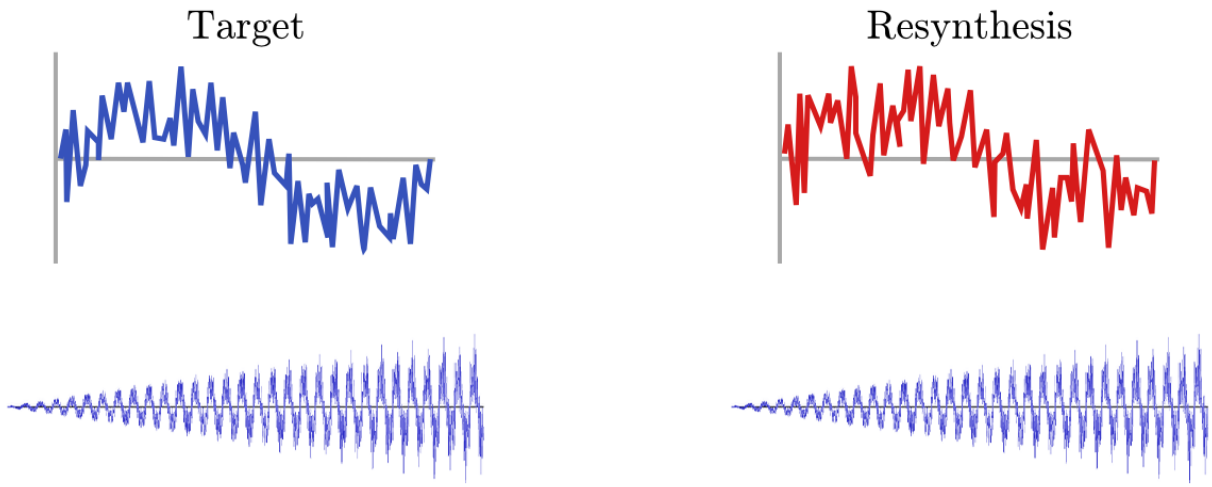
Sawtooth

- A bad match:



The Best Sounds..

- Best sounds to match are those created with synthesizer model to begin with:



Runtime

- Typical run 20 minutes
- Useful for one-off runs, impractical for in-studio use
- Report discusses extensions to improve runtime

Conclusion

- Extended previous work:
  - More complex synth
  - Sounds that change over time
- Innovated with some new techniques
- Best sounds to match = those created by synth